Module 5: Team Tool Kit

Module 5
Team Tool Kit

Upon completion of this module, you will be able to:

- Describe the phases of the PDCA cycle
- Describe the tools available to assist teams using the PDCA cycle
- Use the basic tool kit to develop products using the scenarios provided
- Describe general guidelines for collecting meaningful data

10/95 Team Skills and Concepts - Module 5, Viewgraph 1

Module 5: Team Tool Kit

Upon completion of this module, you will be able to:

- **Describe the phases of the Plan-Do-Check-Act (PDCA) cycle**

You will learn the role of PDCA in process improvement and what each of the phases means.

- **Describe the tools available to assist teams using the PDCA cycle**

We will introduce the basic team tool kit, and you will learn how each tool fits into the PDCA cycle.

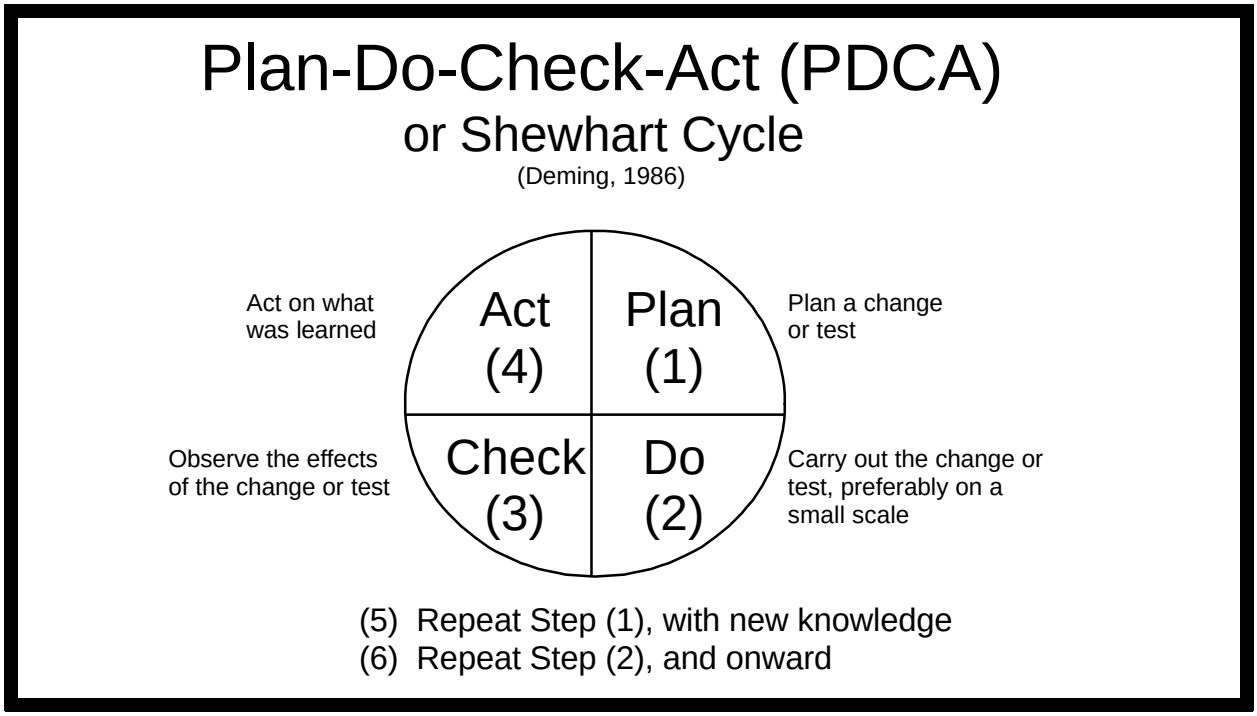
- **Use the basic tool kit to develop products using the scenarios provided**

You will learn how to apply each tool and have the opportunity to practice each one on a sample exercise and then on your team case study scenarios.

- **Describe general guidelines for collecting meaningful data**

You will be introduced to some basic concepts about data and how to plan for effective data collection to improve processes.

So far we have set the stage for the team to look at process improvement. The team has a clear charter, team members have been identified, and roles have been clarified. Your team must have some tools to use in its search for a better way of doing business. There are many tools and techniques available to assist teams in process improvement using the Plan-Do-Check-Act cycle. The ones we will cover today are very basic, but critical to promoting effective process improvement teamwork.



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Plan-Do-Check-Act (PDCA) or Shewhart Cycle

The Plan-Do-Check-Act (PDCA), or Shewhart Cycle, was developed by a physicist named Walter Shewhart, who studied causes of variation in a system of production. Shewhart coined the term "PDCA," but it was Dr. W. Edwards Deming who popularized it as the "Shewhart Cycle." Shewhart believed that systems could be analyzed by applying a scientific method. He developed the PDCA cycle as a way to apply the scientific method to analyze and improve processes. Dr. Deming taught us to use PDCA as a tool involving the systematic collection of data for understanding and improving the operating characteristics of a system.

- **Plan**

The first phase of the PDCA cycle is the PLAN phase. During the PLAN phase, the objective is defined in terms of the quality requirements of the customer: in other words, what the customer wants. The QMB translates customer requirements into operational definitions. (An operational definition defines the quality characteristics of a requirement in measurable terms.) Management must then state what improvement objectives are desired in these quality characteristics. The next step in the plan is to determine an objective way to find out what factor in the system of causes is leading to the variation in the process under study. Employees who are working together as a team and who are knowledgeable about the system will conduct the initial analysis.

Usually, the planning phase is the most time-consuming of all the phases. Although PDCA is represented as having equal parts, the PLAN phase is actually about 75 percent of the cycle.

- **Do**

The second phase of the PDCA cycle is the DO phase. In this phase, a test is performed, usually on a small scale or in an experimental setting. To perform the test it is necessary to first identify possible causes impeding the quality process. This is referred to as baseline measurement or baseline information, which is measuring and seeing what the process currently does in terms of the quality characteristics. The next step is to make a small change to determine whether there is a correlation between the variable that is changed and the quality performance indicators (measurements of quality within the process).

- **Check**

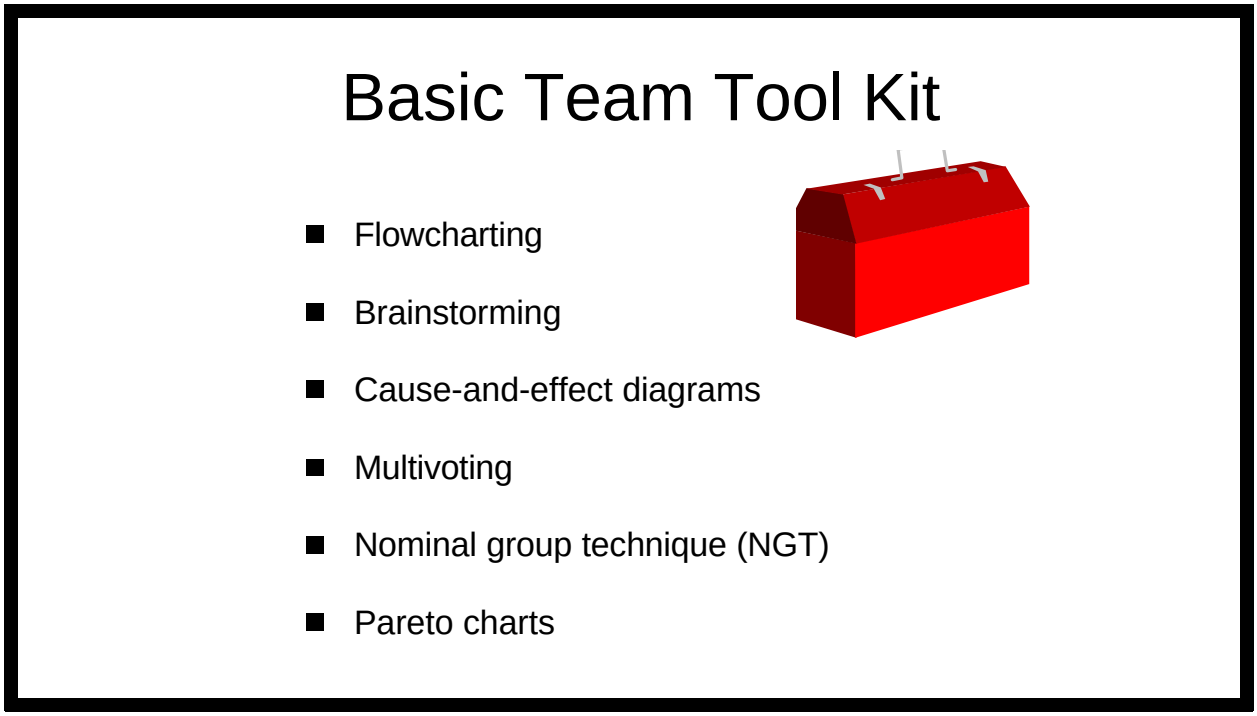
In the CHECK phase, which is the third step of the PDCA, data is analyzed and evaluated to see if the cause has been detected by the test. This analysis pinpoints the cause of the results (good and bad) and is the basis for action by the persons responsible. It often leads to information necessary for improvement in the system.

- **Act**

The ACT phase is the fourth stage. If the test conducted in the DO phase reveals an improvement in the CHECK phase, then action is taken to standardize the change. The effectiveness of the change is evaluated by comparing the data collected after the change with that collected before the change. If improvement is not seen, the "act" decision may be to collect more data and begin again. The process needs to be continuously monitored to ensure that the desired effect is sustained and to identify new opportunities for improvement. Monitoring is conducted by applying statistical tools. The cycle does not end with ACT; PDCA is a continuous cycle of learning and improvement.

This approach to quality improvement may appear similar to troubleshooting or other systematic approaches to problem solving. However, PDCA is not the way managers have typically handled problems. The typical behavior of managers has been to PLAN and then jump straight to the ACT phase. Once they thought they knew what the cause of the problem was or its solution, they wanted to fix it right away. The prevailing attitude has been, "There, we've fixed that. What's next?" But a solution arrived at in that way may not be correct or complete, because it generally focuses on only one facet or component of the larger process. This omission can only be known through data collection and analysis. Process capability studies have shown that sometimes a temporary "fix" can introduce more variation into a process than it had at the beginning. So it is necessary to go through a disciplined, data-based procedure (scientific process or method) to determine whether or not the proposed changes are appropriate.

The PDCA cycle can be used at all levels of an organization and for all kinds of improvements. The scope and emphasis of process improvement will vary at different levels. The PDCA cycle serves as a framework for the application of statistical methods to examine and improve processes.



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Basic Team Tool Kit

To get you started, we will explore some basic tools selected from among the many that you may use on your teams. We are focusing on the tools that involve team dynamics and the scientific process:

- **Flowcharting**

- **Brainstorming**

- **Cause-and-effect diagrams**

- **Multivoting**

- **Nominal group technique (NGT)**

- **Pareto charts**

There are some tools a team will use at practically every meeting—those that help them explore ideas and make decisions. Anyone who has any experience working in groups will appreciate how difficult it is to develop creative ways to approach a task. It is sometimes even more difficult to select only one or two items to work on from all the possibilities generated. As you will see in a few minutes, the basic tools you are going to learn about will help you in these areas.

The roadmap for process improvement is not always clear, especially when teams are just beginning process improvement initiatives. They may use tools inappropriately at first, or be confused about what tools to use in what sequence. Using a different tool or displaying data in a different format often helps teams overcome these problems and move forward.

You will also see, it usually makes sense to use one type of tool before another, but you don't always use all of the tools or use them in exactly the same order every time.

Purpose of Tools

- Visualize a process
- Pinpoint potential areas for improvement
- Find root causes
- Determine changes
- Implement proposed changes and evaluate effects of changes

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Purpose of Tools

Why are the tools used?

- **Visualize a process**

Flowcharts are used to display the steps and activities in a process or system and how they interact. A picture of the process tells much more than words alone.

- **Pinpoint potential areas for improvement**

A team often brainstorms to identify opportunities for improving the process. Nominal group technique and Pareto analysis may be used to help the team define which part of the process to tackle first.

- **Find root causes**

Once the team has identified the improvement area, cause-and-effect diagrams are used to find the root causes of variation.

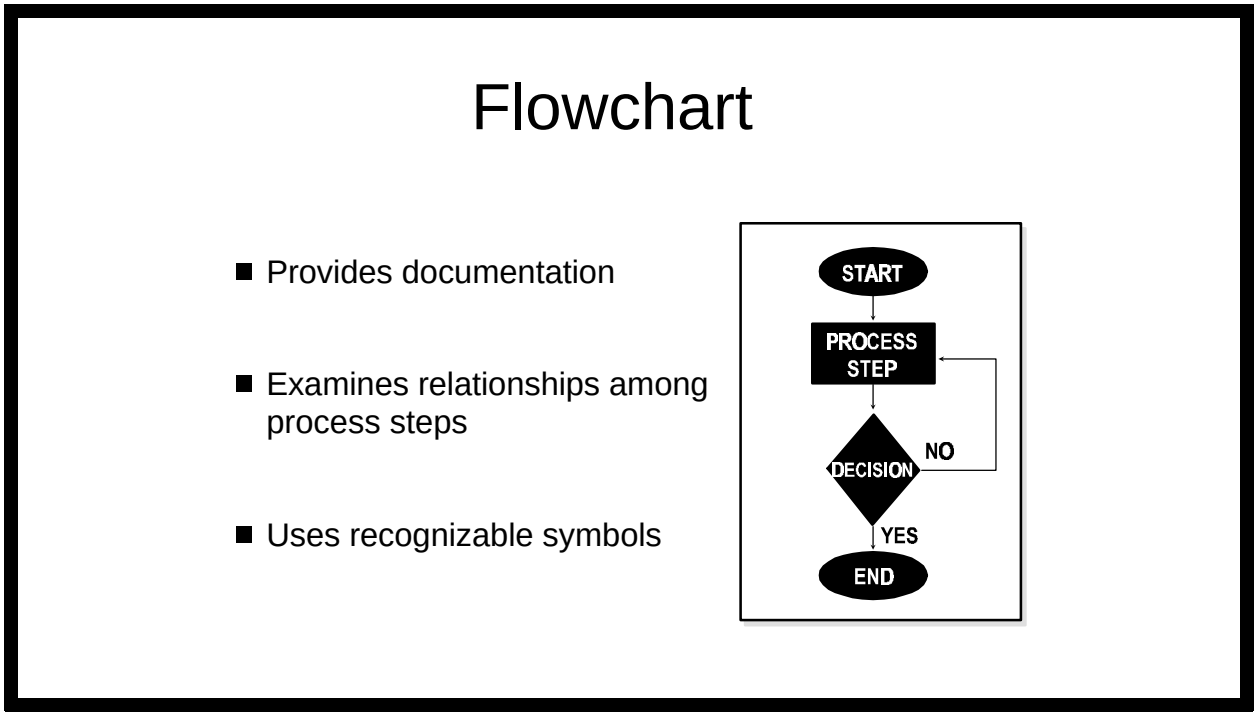
- **Determine changes**

Before you can determine changes which will improve the process, you must collect and analyze data on the process. Check sheets, Pareto analysis, pie charts, run and control charts, histograms, and scatter diagrams are used to collect and analyze data. Most of these graphic tools are taught in the *Systems Approach to Process Improvement* (SAPI) course.

- **Implement proposed changes and evaluate effects of changes**

Once the team has implemented a data-based improvement in the process or system, continuous monitoring must be done to ensure that it is actually doing what it is supposed to do. Data collection and analysis will again be used. Some people think that having collected and analyzed data once, no other action is required of them.

All of the steps we have just discussed—reviewing and identifying the steps in the process, collecting and analyzing data, making the change, and constantly monitoring the process improvement—are part of the improvement process known as the PDCA cycle, which we just discussed.



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Flowchart

- **Provides documentation**

A flowchart provides excellent documentation of a process. A flowchart is typically used to define a process and its boundaries in the PLAN phase of the PDCA cycle. Flowcharting is applicable to any process. In fact, if it can't be flowcharted, it's not a process!

- **Examines relationships among process steps**

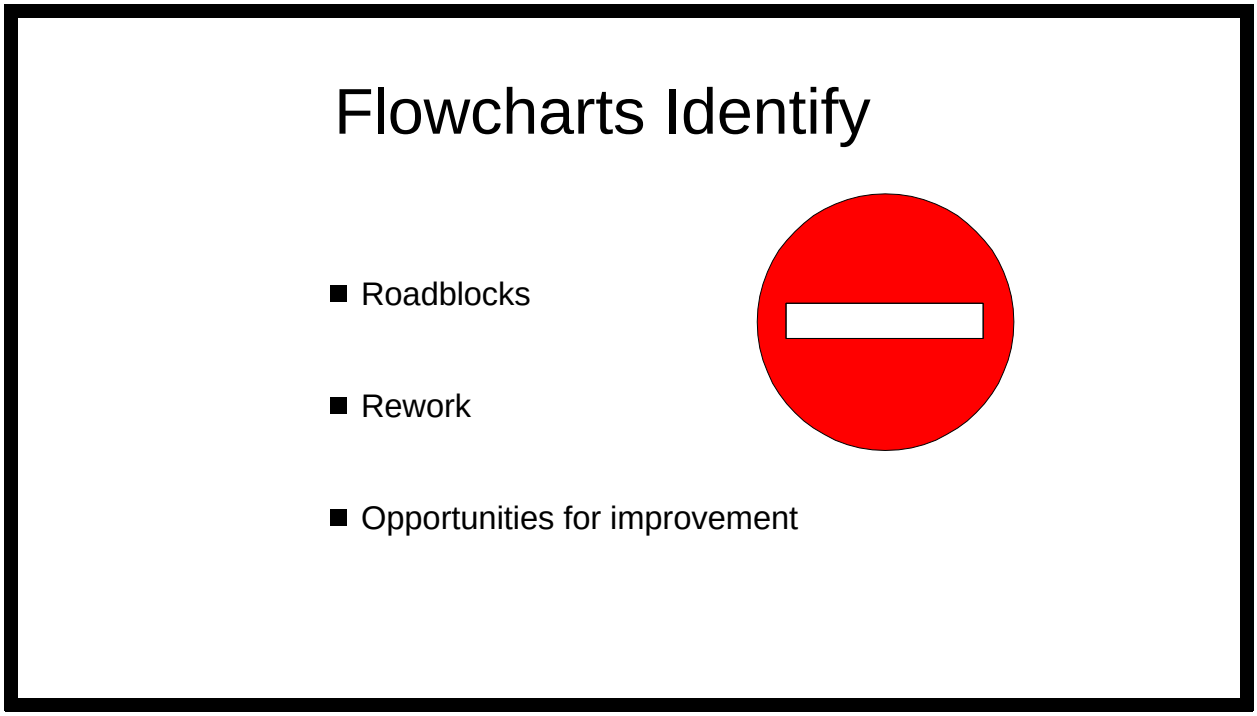
Flowcharting aids in the understanding of complex processes by examining relationships among process steps. It can be applied to anything from the routing of an invoice to the steps involved in docking a ship.

- **Uses recognizable symbols**

Flowcharts use common, recognizable symbols to represent the type of processing performed. Ovals are used to depict the beginning and the ending of a process. A rectangle or square represents a particular step or activity in the process. A diamond represents a decision point. Arrows show the movement or flow of the process from one step or decision point to the next. A diamond has two arrows, one signifying a "yes/go" decision and the other signifying a "no/no-go" decision.

You can construct a simple "macro" or big picture flowchart of a process as it is supposed to be working (by regulations) and how it is actually working (as is). "As-is" flowcharting is done in order to identify how the process actually works. To describe the actual process flow, you need to bring in the people who work in the process to discover the paths or steps taken in the process and the actual relationships among the various individuals and departments in the process.

If you can't depict the process flow, you probably don't understand it. In fact, experience has shown that some processes are so complex that no one person can describe all of the steps. Thus, another advantage of teamwork is to bring together individuals who are familiar with various stages of the process to construct a flowchart of the actual process.



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Flowcharts Identify

Flowcharts identify existing roadblocks or rework in the process and may help you differentiate between steps that add true value and those that only add cost to the process.

- **Roadblocks**

Flowcharting the actual process is a relatively simple way to identify roadblocks. A roadblock can be defined as anything obstructing progress or standing in the way of doing a quality job.

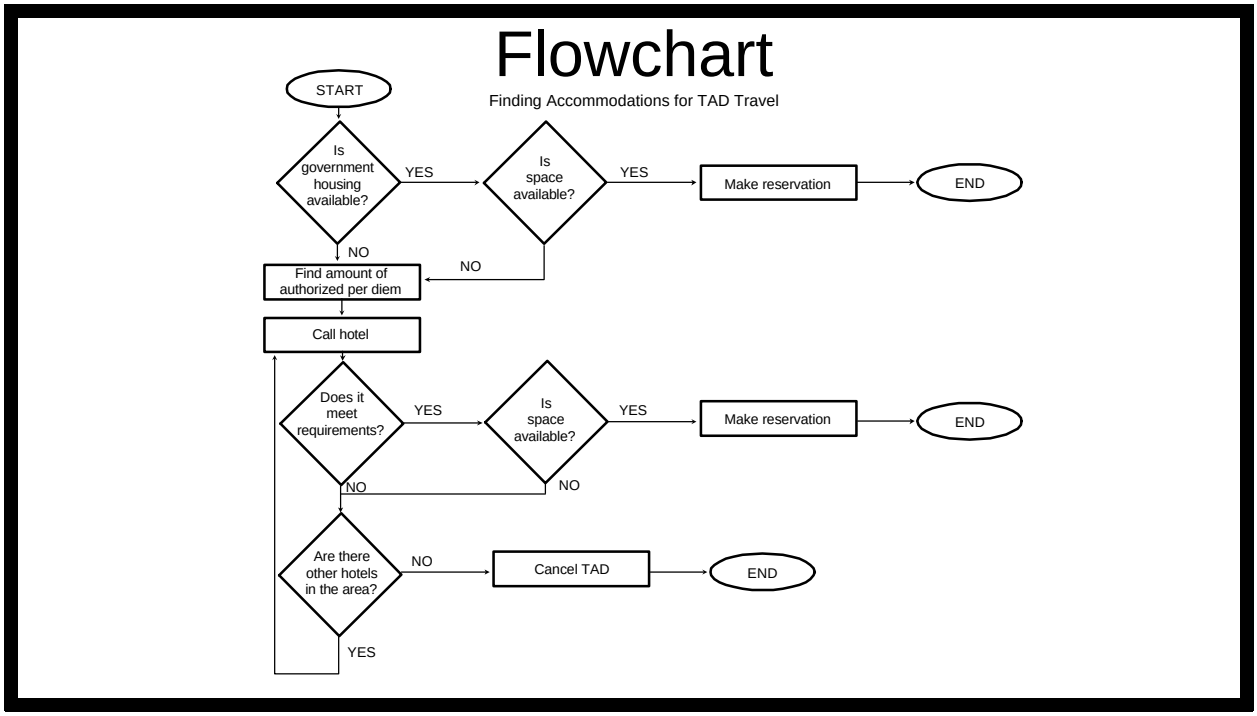
- **Rework**

Flowcharts also identify rework in a process. Substantial gains in quality and productivity will occur as rework is reduced or eliminated. Rework can be defined as any task performed because the job was not done correctly the first time. In manufacturing, rework is easily identified, but in a service industry, rework is often more subtle.

- **Opportunities for improvement**

Finally, you can construct your "ideal" flowchart of the process as you would like to see it. By identifying the roadblocks and rework from the flowcharts, there is a basis for identifying what can be done to make improvements. A comparison of the actual (as is) and ideal charts will visually display the differences and direct (or document) your improvement efforts. The use of flowcharts to define and refine processes is covered in detail in the *MMQ* course.

This process also helps you determine where measurements should be taken and what kind of measurements they should be.



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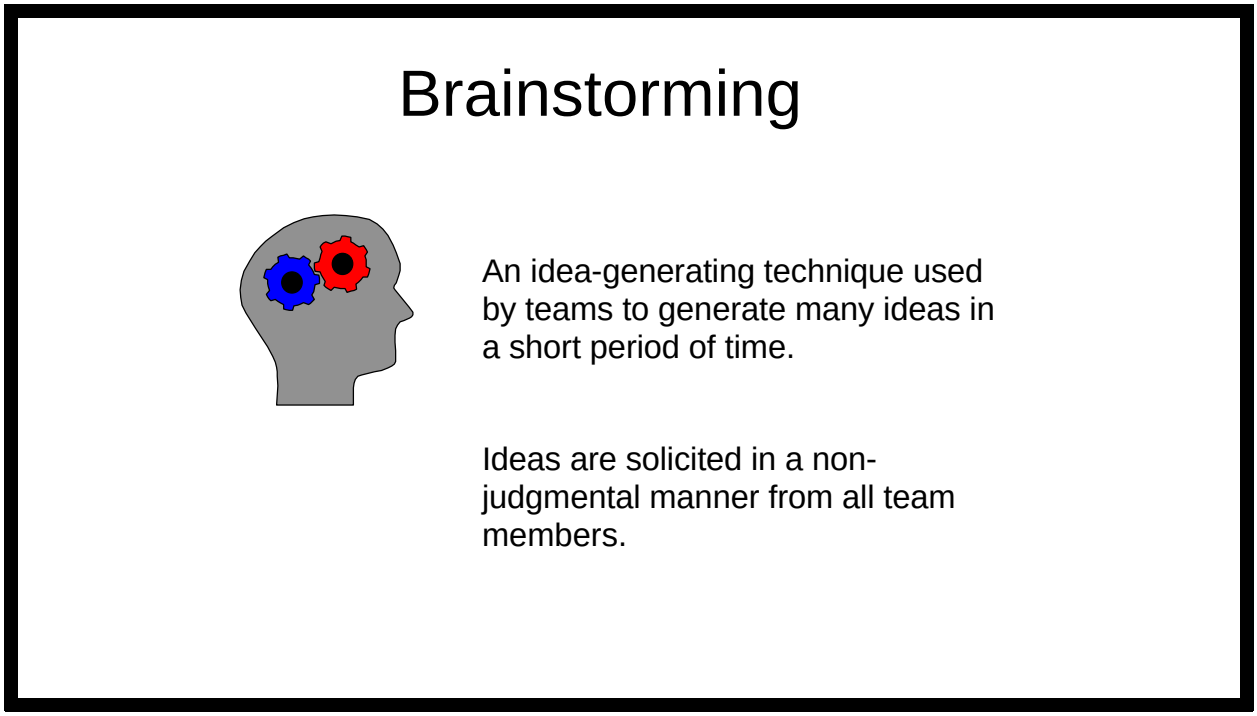
Flowchart: Finding Accommodations for TAD Travel

Before we go further into the case study, let's take a sample process and construct a simple flowchart. Let's take one we're probably all familiar with, "Finding accommodations for TAD travel."

The first step is to see whether there is government housing available at the site. If not, proceed to commercial reservations. If there is government housing available, call to see if there is space available. If so, make the reservation and receive a confirmation number, bringing the process to an end. If there is no space available, proceed to the commercial process. You must find out what the authorized per diem is and locate a hotel that meets the requirements of per diem and locality. You must search until you find suitable lodging. When you find a hotel that meets the requirements, make a reservation and receive a confirmation number, ending the process. We will assume that the TAD assignment will be cancelled if you are able to find suitable accommodations.

"AS-IS" FLOWCHART CASE STUDY EXERCISE NOTES

As you can see by comparing your "as-is" flowchart to Handout 5-3 or 5-4, your flowchart may look different from someone else's. However, both show a clear picture of the process as it occurs and are equally valid. You may have been tempted to improve the process as you flowcharted it. This is not unusual. But remember, you need to carefully define the process and collect some data before you start making changes.



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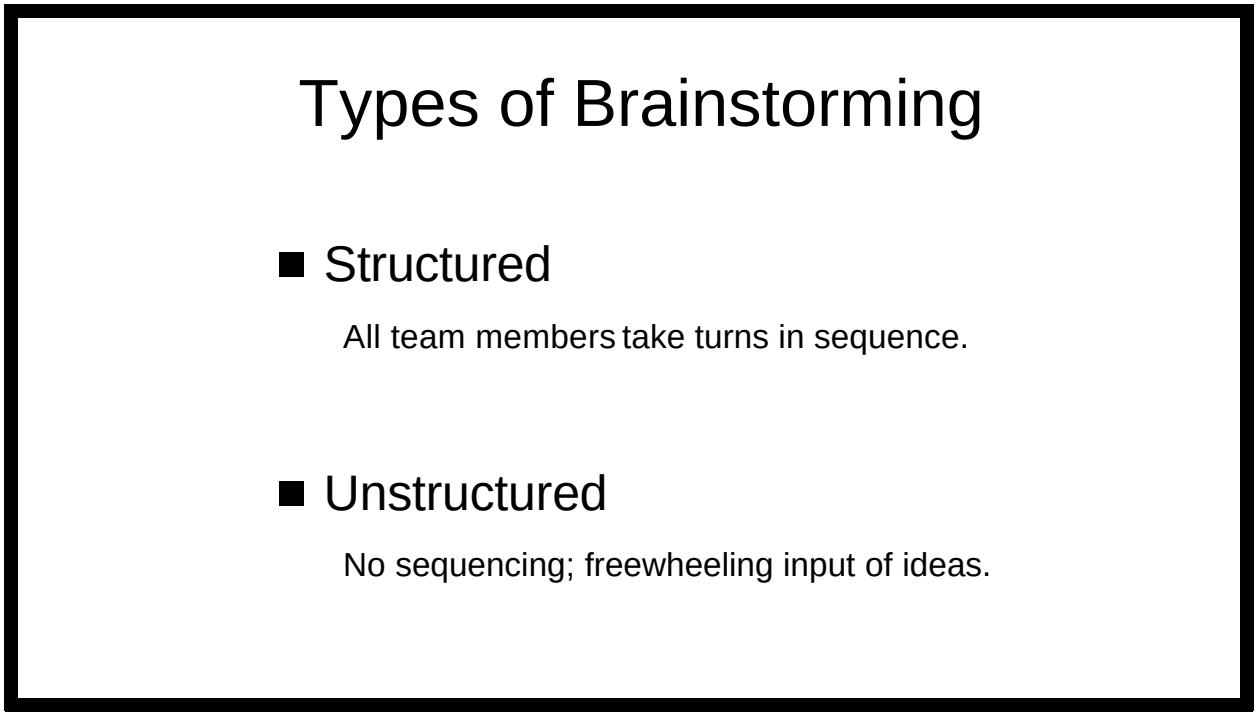
Brainstorming

Having defined the process, the next step for most teams is to start exploring opportunities for improvement. Many of you have heard of the "brainstorming" technique for generating ideas, and we have used the term loosely throughout the course when we asked you to list ideas on a topic. Now let's learn more about how to use this tool.

Brainstorming is an idea-generating technique used by teams to generate many ideas in a short period of time. Ideas are solicited in a nonjudgmental manner from all team members (*DON TQL Glossary*).

Brainstorming allows teams to explore as broad a range of options as possible before they have to make a decision. It also creates excitement and energy as people build off of each other's ideas.



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Types of Brainstorming

There are two types of brainstorming: structured and unstructured.

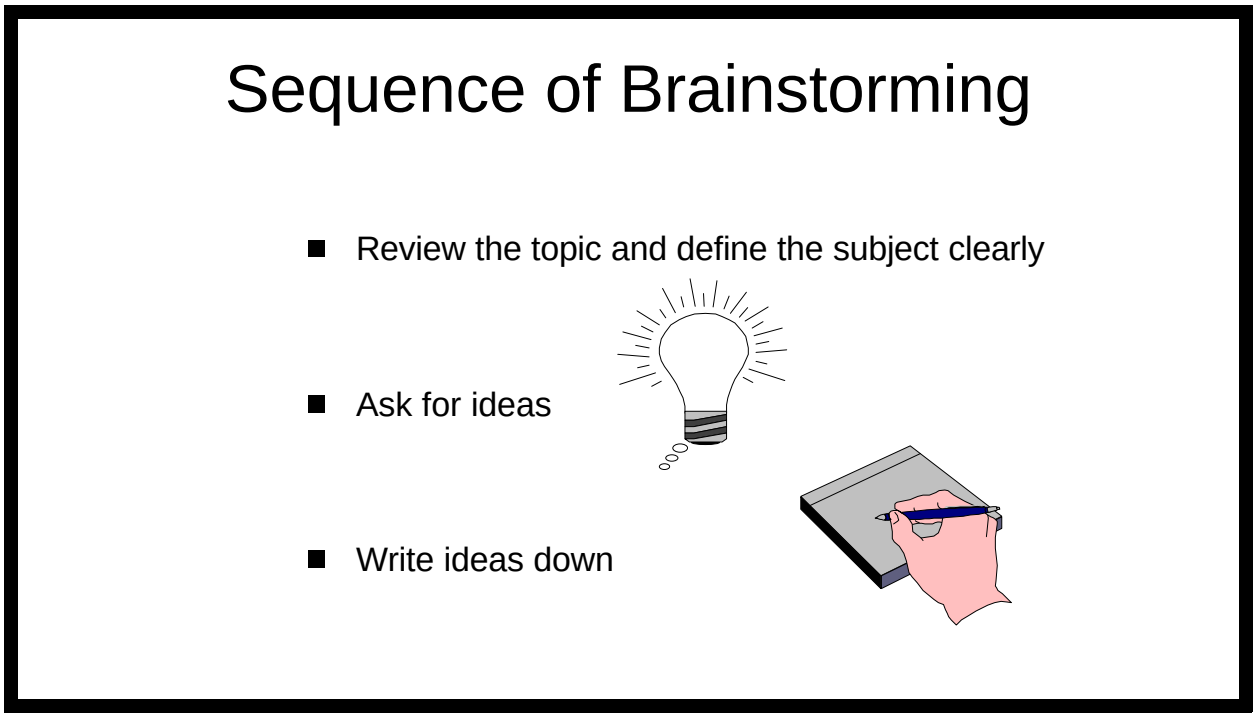
- **Structured**

All team members take turns in sequence. The quality advisor or team leader asks each team member for an idea in a rotational basis. If the person does not have an idea at that moment, he or she can pass until the next round. This technique encourages shy people to participate but can also create a certain amount of pressure to contribute.

- **Unstructured**

No sequencing; freewheeling input of ideas. Team members simply call out ideas as they come to mind. It tends to create a more informal and energetic atmosphere but also risks domination by the most vocal members.

If a team is just starting to work together, structured brainstorming may be preferred since everybody participates and communication and teamwork are enhanced. Many teams find that the most productive brainstorming session is one that starts structured, then goes to unstructured as momentum builds.



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Sequence of Brainstorming

The general format of a structured or unstructured brainstorming session is to:

- **Review the topic and define the subject clearly**

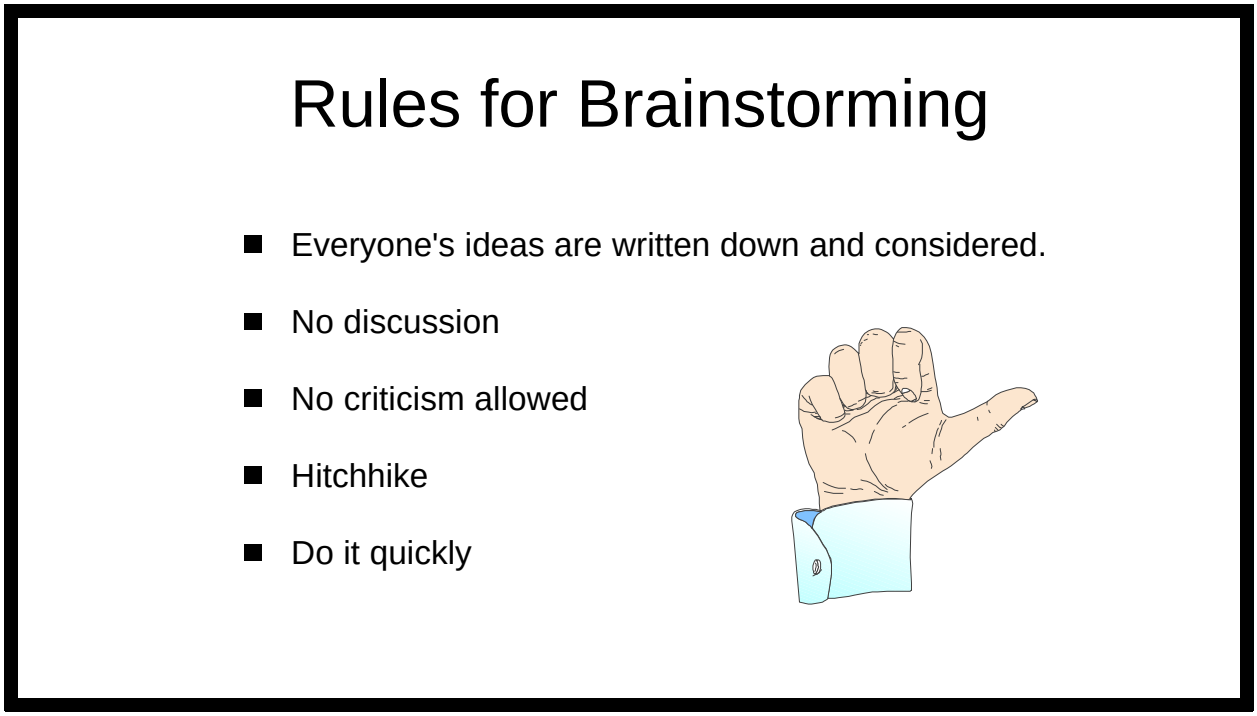
Often this is done best as a "why," "how," or "what" question. An example of our mailroom PAT could be: "Why does internal mail distribution take five days?"

- **Ask for ideas**

The quality advisor or the team leader should solicit the ideas from each team member. Be sure not to allow any discussion at this point.

- **Write ideas down**

One of the team members or the quality advisor should write all the ideas down, only asking questions for accuracy. The ideas should be written in large letters and posted so that everyone can read them to "hitchhike" on each others' ideas. This is what creates the synergistic effect of brainstorming, which leads us to the rules of brainstorming.



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Rules for Brainstorming

When a team is brainstorming, in either the structured or unstructured mode, the following rules should be followed to make the session effective and promote team cohesion.

- **Everyone's ideas are written down and considered.**

Write every idea on a chartpack or chalkboard. Having the words visible to everyone at the same time avoids misunderstandings and reminds others of new ideas. Record the speaker's words exactly; don't try to interpret.

- **No discussion**

Don't stop for team members to ask questions or debate during the brainstorm. Ideas will be discussed after the session in greater detail.

- **No criticism allowed**

This includes verbal and nonverbal communication, such as groaning, rolling your eyes, or making faces.

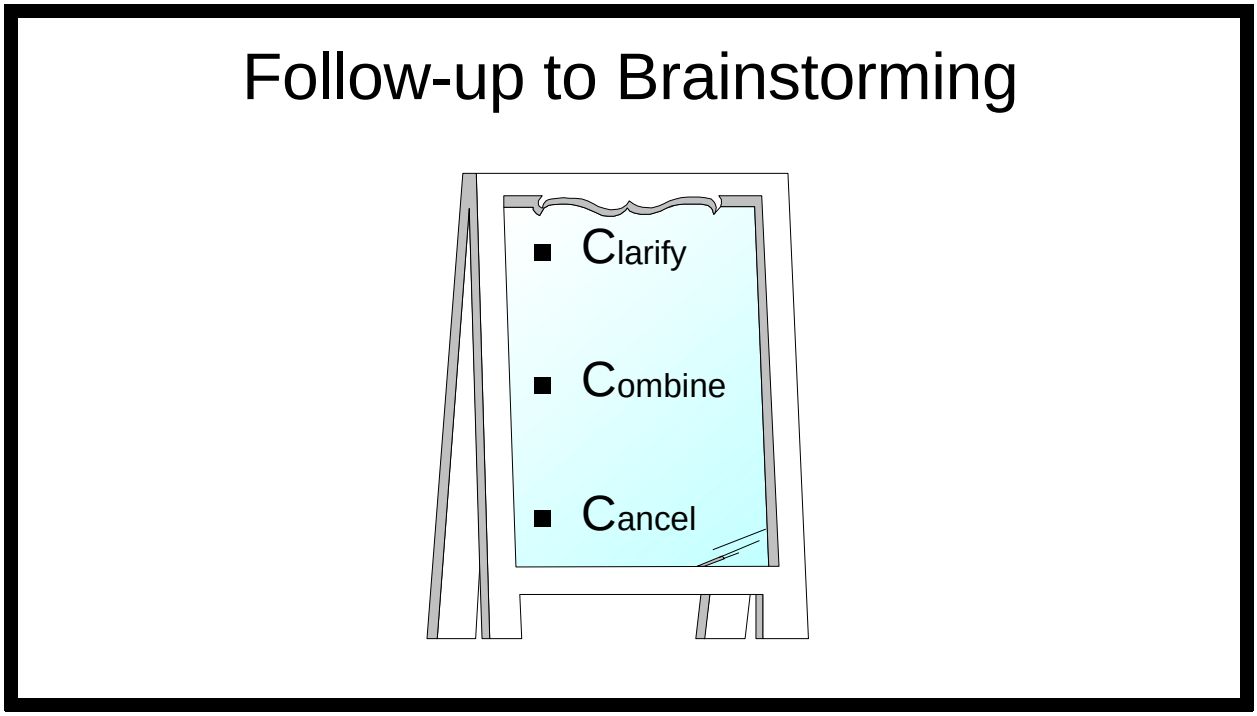
- **Hitchhike**

Encourage people to hitchhike or piggyback on others' ideas. Hitchhiking helps build upon ideas generated by others on the team.

- **Do it quickly**

Take approximately 5 to 15 minutes for most subjects. Fast-paced generation of ideas helps make the session more energetic, free-wheeling, and productive. People don't have time to stop to think about their ideas. They just blurt them out, which is what you want—a lively, uncensored free flow of ideas.

Chapter 2 in *The Team Handbook* also discusses brainstorming.



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Follow-up to Brainstorming

When a team has generated a list through brainstorming, it must then seek to ensure that the list is inclusive, understood, and free of redundancies.

- **Clarify**

As we saw in Module 2, we have a tendency to express ourselves in colloquialisms and personal jargon. The quality advisor or team leader must make sure that all have a clear definition of each term on the list.

- **Combine**

Once all the items have been defined, we may find that various members have listed the same thoughts. Ask the authors of the seemingly redundant ideas whether they are willing to have them combined into a single item.

- **Cancel**

If we have combined items, some ideas may be discarded, but only if they have been combined with another. Only the team member who submitted the idea may agree to the combination or cancellation of the idea. Once you begin to refine the list, you may also find that some ideas are so far out that they can be discarded. If you've had a really free-wheeling session, you'll even have some "joke" items that invoked humor, but aren't all that viable. This is the time to get rid of them.

This method, if conducted immediately after the brainstorming session, allows the team to fully understand all items on their list and to ensure that there are no duplicates.

CAUTION**:** Some teams will go beyond the intent of this step and reduce their list to only a few items. Try to keep the combine and cancel steps to only the obvious few. In a few minutes, we will discuss other tools to use if you need to refine the list to the most important items.

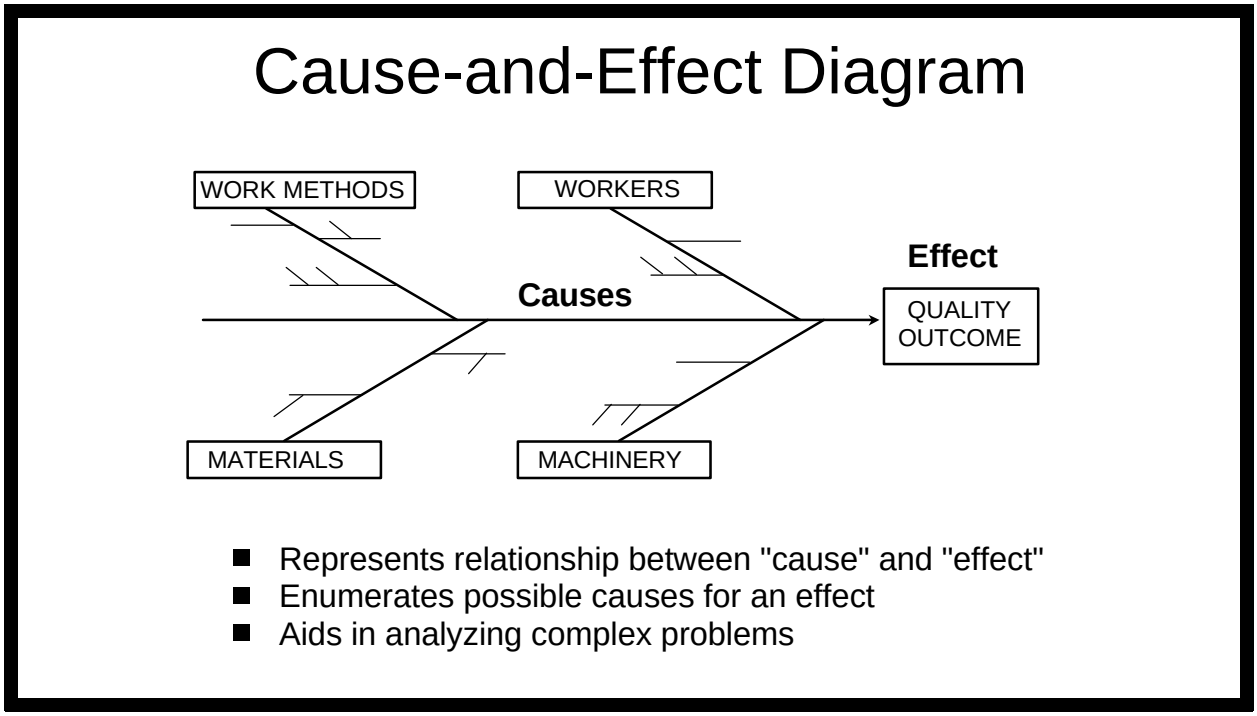
PRACTICE EXERCISE NOTES

BRAINSTORMING CASE STUDY EXERCISE NOTES

Whether you use the structured or unstructured approach (or both), it is important to follow the rules of brainstorming and to follow up with clarify, combine, and cancel. Most teams that follow this guidance will find that more ideas are generated, people participate more, and there is a wider range of ideas.

Many teams have mistakenly come to think that any time a group of people sits around a table and discusses ideas, they are brainstorming. You now know that unless it's an uncensored, free flow of ideas in which *everyone* participates, it's probably not brainstorming.

We will now take brainstorming a step further and use it in the next tool, which is a cause-and-effect diagram.



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Cause-and-Effect Diagram

- **Represents relationship between "cause" and "effect"**

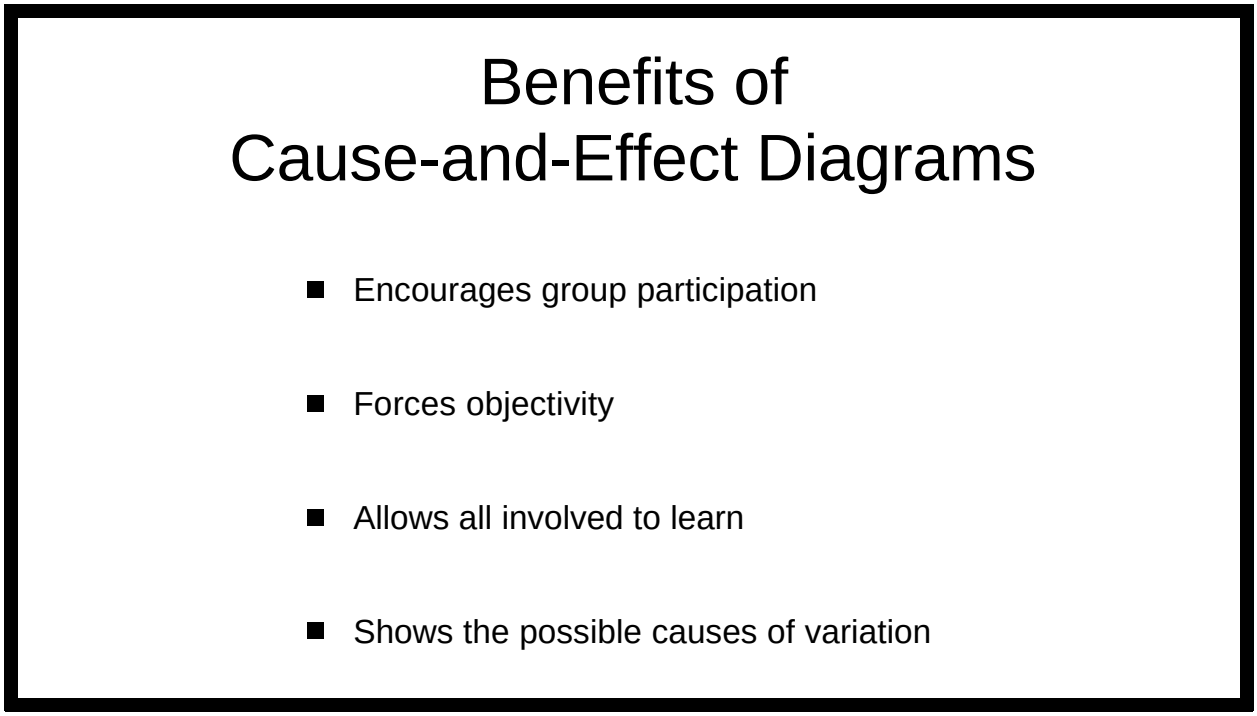
A cause-and-effect diagram, also known as the "fishbone" diagram, is used to illustrate the relationship between an effect and possible causes influencing it. The fishbone nickname derives from the resemblance to the skeleton of a fish. The effect or issue is stated on the right side of the chart and the major influences or "causes" are listed to the left.

- **Enumerates possible causes for an effect**

The chart allows us to differentiate between causes and symptoms and enables us to identify and select causes for further analysis.

- **Aids in analyzing complex problems**

The chart can be used to define, summarize, and categorize possible causes and help to organize, interpret, and analyze the process. Four major categories most often used are: work methods, workers, materials, and machinery.



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Benefits of Cause-and-Effect Diagrams

Some of the benefits of using the cause-and-effect diagram are that it:

- **Encourages group participation**

It utilizes group knowledge rather than allowing arbitrary guesswork and finger pointing.

- **Forces objectivity**

Cause-and-effect diagrams help eliminate long-held perceptions of causes (myths) by systematically representing possible causes and effects.

- **Allows all involved to learn**

By involving all team members in organizing and analyzing the process, this too enables everyone to learn more about the process.

- **Shows the possible causes of variation**

Cause-and-effect diagrams display potential root causes of process variation.

Cause-and-effect diagrams are usually generated by brainstorming about possible causes without previous preparation.

A new team may be more comfortable by first brainstorming the items and then putting them on the cause-and-effect diagram. Once you are comfortable with the technique, you can put the items directly on the chart as you brainstorm.

PRACTICE EXERCISE NOTES

CAUSE-AND-EFFECT DIAGRAM CASE STUDY EXERCISE NOTES

After you have created the cause-and-effect diagram, find the most important root causes of variation in the process by:

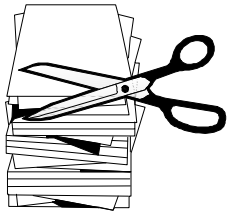
Looking for causes that appear repeatedly

Reaching a team consensus

Gathering data to determine the relative frequencies of the different causes

Remember that cause-and-effect diagrams identify only **possible** causes. Even when everyone agrees on these possible causes, only data will point to **actual** causes.

Multivoting



A repetitive process used by a team to conduct a straw poll to select the most important or popular items from a large list of items generated by the team. The process is conducted with limited discussion and difficulty.

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Multivoting

Multivoting is a repetitive process used by a team to conduct a straw poll to select the most important or popular items from a large list of items generated by the team. The process is conducted with limited discussion and difficulty (*DON TQL Glossary*).

Multivoting is a tool used to quickly and easily select the most important or popular items from a list. This is accomplished through a series of votes, each cutting the list by a specified amount, usually one-half. Multivoting can follow a brainstorming session to identify items needing immediate attention.

STEP 1
To conduct a multivote, you must first generate (usually by brainstorming) and number a list of items. If there are like items, combine them, but only if the group agrees by consensus.

STEP 2
For the first round, have each team member silently select a number of choices that are at least one-third of the total items on the list. For example, if you have 60 items, choose 20, or for 48 items, choose 16. Do NOT prioritize them.

STEP 3
Compile the votes for each item either by a show of hands or secret ballot. To reduce the list, eliminate those items with the fewest votes (generally four votes or less).

Continue to do Steps 2 and 3 until only a few items remain and/or one emerges as the most popular or important.

PRACTICE EXERCISE NOTES

Say that in your TAD exercise you brainstormed 30 items; one-third of this list would be 10 items. Each of you should silently write down the 10 items you think are most important. Have your recorder or quality advisor tally the votes, and then eliminate those with the fewest votes. Continue by voting on the top three or four out of those 10 until one is identified as the most popular or important.

MULTIVOTING CASE STUDY EXERCISE NOTES

Additional information on multivoting can be found in *The Team Handbook* on pages 2-39 through 2-41.

Multivoting is one method of moving team members toward consensus on what is important. However, if you wish to use a technique with more restricted interaction between participants, nominal group technique is effective.

Nominal Group Technique (NGT)

A weighted ranking technique that allows a team to generate and prioritize a large number of issues without creating "winners" and "losers" among the team members.

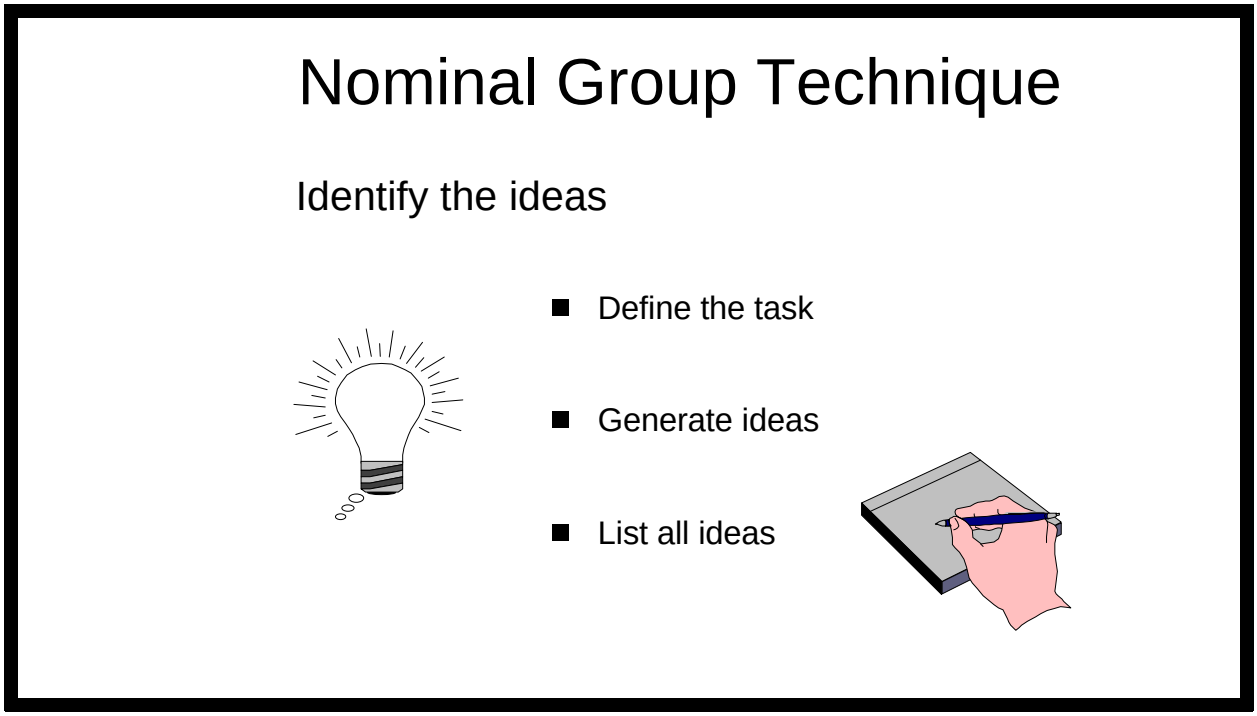
10/95 Team Skills and Concepts - Module 5, Viewgraph 16

Nominal Group Technique (NGT)

NGT is a weighted ranking technique that allows a team to generate and prioritize a large number of issues without creating "winners" and "losers" among the team members.

NGT is a two-part, structured approach used to generate a list of options and narrow it down. NGT provides a way to give everyone in the group an equal voice rather than the loudest person or the person in authority imposing his or her decision on the team.

Additional information is in *The Team Handbook* on pages 2-43 through 2-45.



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Nominal Group Technique

Identify the ideas

- **Define the task**

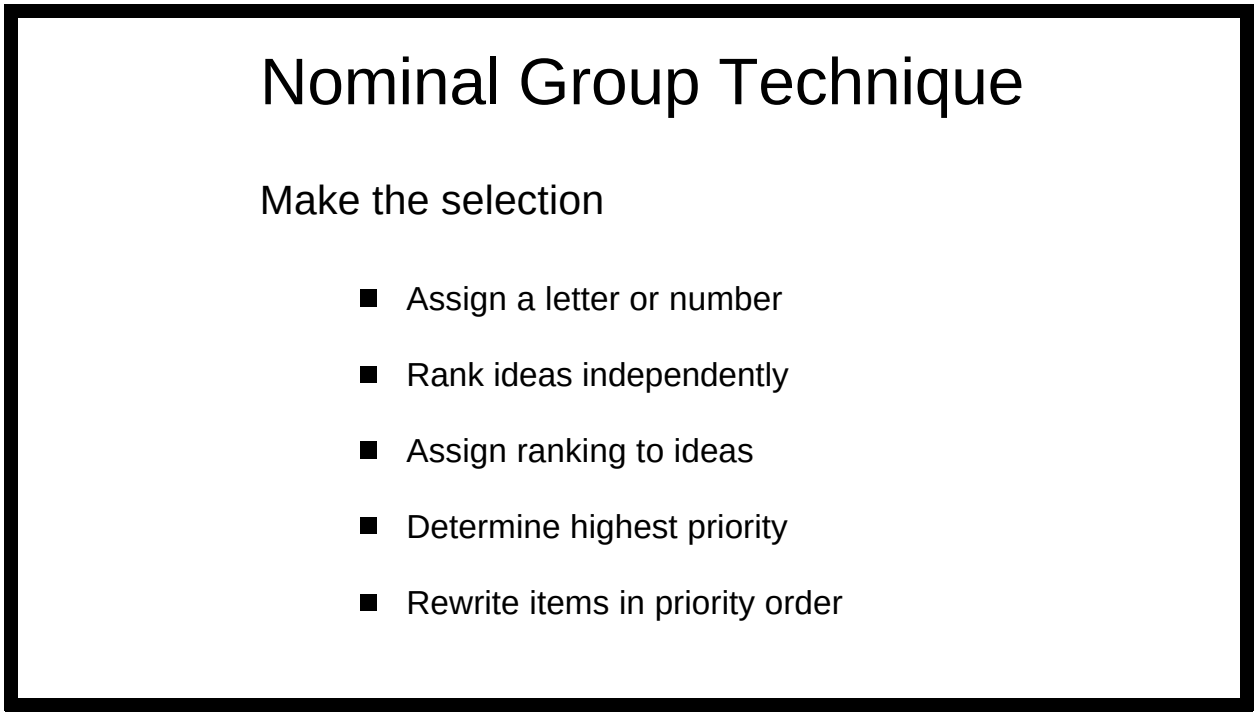
It is best to do this in the form of a question. Make sure you clarify the question and write it so that everyone can see it.

- **Generate ideas**

Either have the team write down its ideas in silence and then conduct a structured brainstorming session or take the "causes" right off the cause-and-effect diagram and give participants a chance to write in any other ideas they have thought of. Whichever way you choose, it's important that everyone has a chance to silently and individually generate ideas.

- **List all ideas**

List all the ideas given. Clarify and discuss these ideas after everything has been listed. Similar ideas can be combined if the originators agree. If the person who suggested the idea believes there is a difference, leave the ideas listed separately.



10/95 Team Skills and Concepts - Module 5, Viewgraph 18

Nominal Group Technique

Make the selection

- **Assign a letter or number**

Assign a letter or number to each separate item. If the list is large, you may want to concentrate on the top five.

- **Rank ideas independently**

Have the team write down independently which items are most important by ranking them one to five (five being the most important).

- **Assign ranking to ideas**

The quality advisor of team leader should then ask each person for his or her top five rankings and place the corresponding number next to the item.

- **Determine highest priority**

After all members have given their top five priorities, add the numbers across. The item with the highest point total is the one of most importance to the whole team.

- **Rewrite items in priority order**

Rewrite the items in order of importance and discuss them. If the team agrees with the items chosen, they move on to developing baseline measurements through data collection procedures. If members do not agree, the team can focus its efforts on investigating the top two or three topics.

Benefits of Nominal Group Technique

- Promotes consensus
- Reduces unproductive conflict
- Helps to clarify and order options

10/95 Team Skills and Concepts - Module 5, Viewgraph 19

Benefits of Nominal Group Technique

NGT is a good team tool to use because it:

- **Promotes consensus**

Since all members have participated in the process, they are more likely to support the results. The choice may not be everyone's first priority, but they can live with it.

- **Reduces unproductive conflict**

Unproductive conflict is minimized because everyone has had a chance to give his or her input to the process in a fair and equal manner.

- **Helps to clarify and order options**

This structured approach helps to prioritize and order items into a workable number.

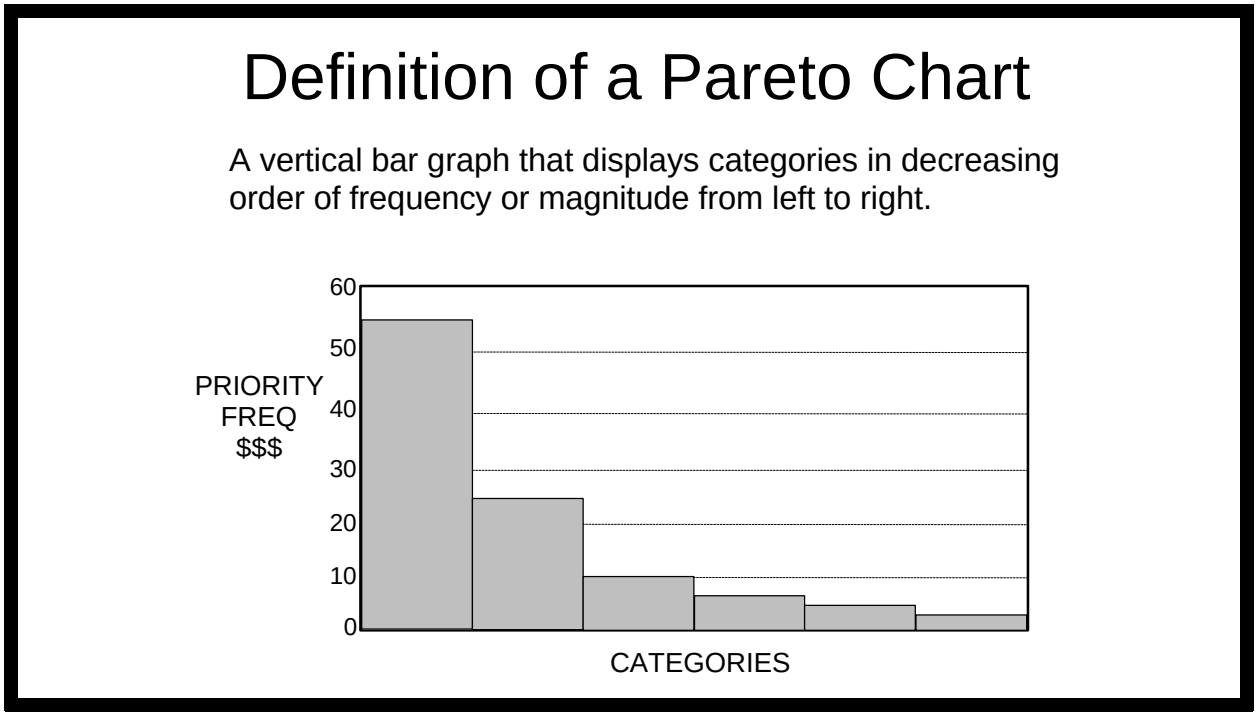
PRACTICE EXERCISE NOTES

NOMINAL GROUP TECHNIQUE CASE STUDY EXERCISE NOTES

Generally, you would use multivoting when you have a large list of items. If you wish, you could multivote your list down and then prioritize using NGT.

You may notice we picked five for the number of your top priorities; however, it does not have to be five. It could be the top three or top ten; whatever your team feels is a comfortable number to work with. Do not throw away your entire list after you have prioritized your choices; retain this for future action and knowledge.

Once your team has picked your top priorities, you do not necessarily have to work on them in the order chosen. Your team may want to start with one of the processes that may be not quite as difficult, at least until your team becomes more knowledgeable in the skills and tools required.



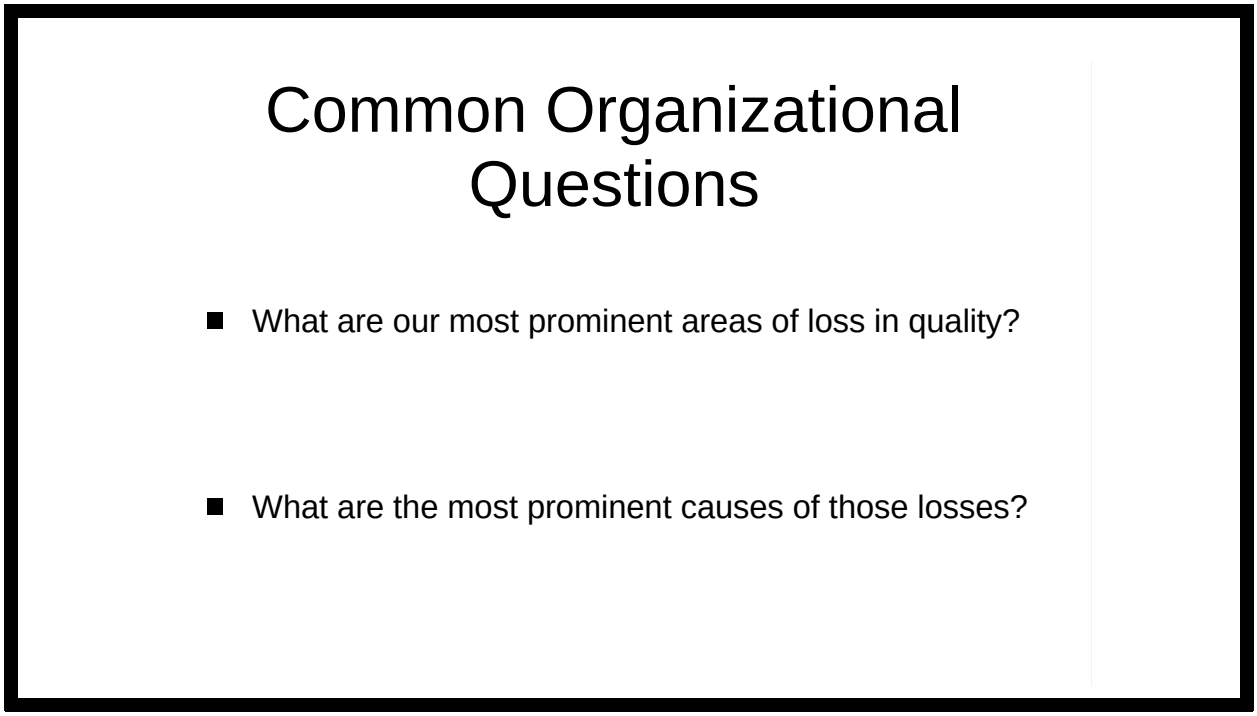
10/95 Team Skills and Concepts - Module 5, Viewgraph 20

Definition of a Pareto Chart

A Pareto chart is a vertical bar graph that displays categories in decreasing order of frequency or magnitude from left to right (*DON TQL Glossary*).

You may have prioritized things this way in the past without realizing you were using a Pareto chart. You may not have said, "I'll diagram the order of value to decide which item will be worked first," but you may have used this concept to manage your own resources or processes without giving it a name.

Now, let's look at how this concept can be used to help us improve quality.



10/95 Team Skills and Concepts - Module 5, Viewgraph 21

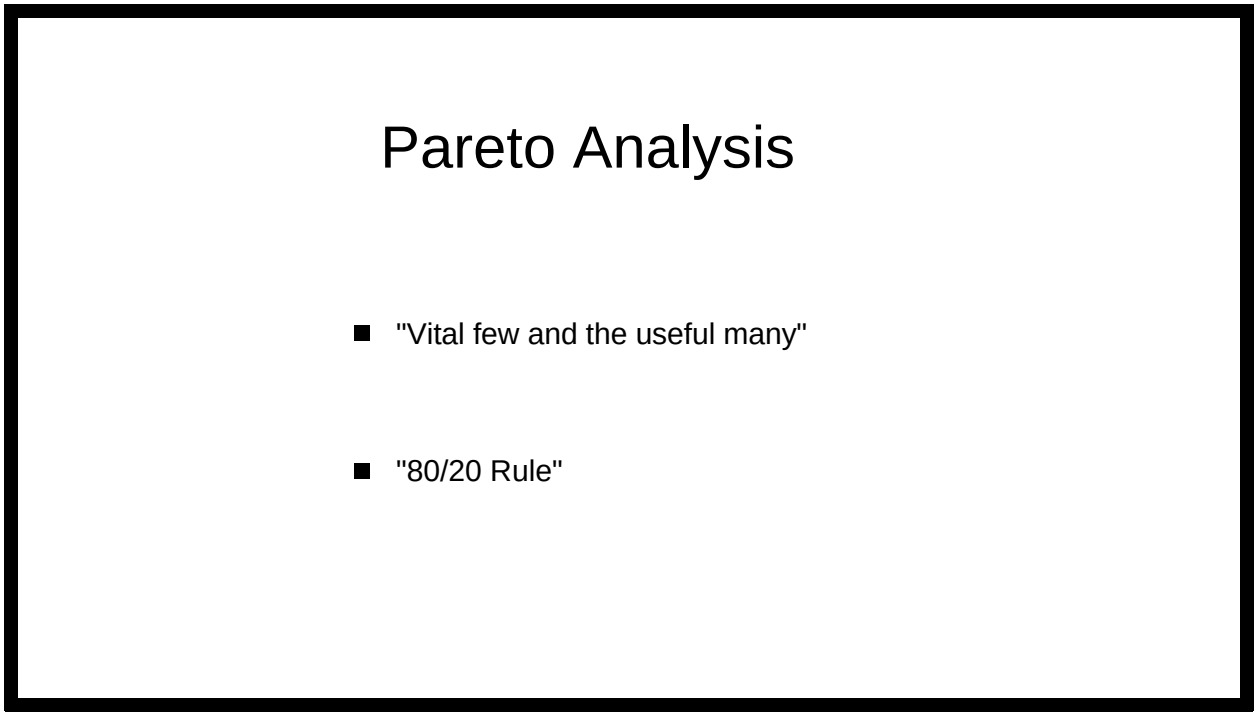
Common Organizational Questions

Pareto charts can be used to answer two basic questions at all levels in the organization, including the mission, goal, objective, system, process, and task levels:

- **What are our most prominent areas of loss in quality?**

- **What are the most prominent causes of those losses?**

The consideration of these questions provides a systematic approach for choosing which areas of the process should be studied first.



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Pareto Analysis

One way to answer these questions of how to affect the greatest improvement is to identify the:

- **"Vital few and the useful many"**

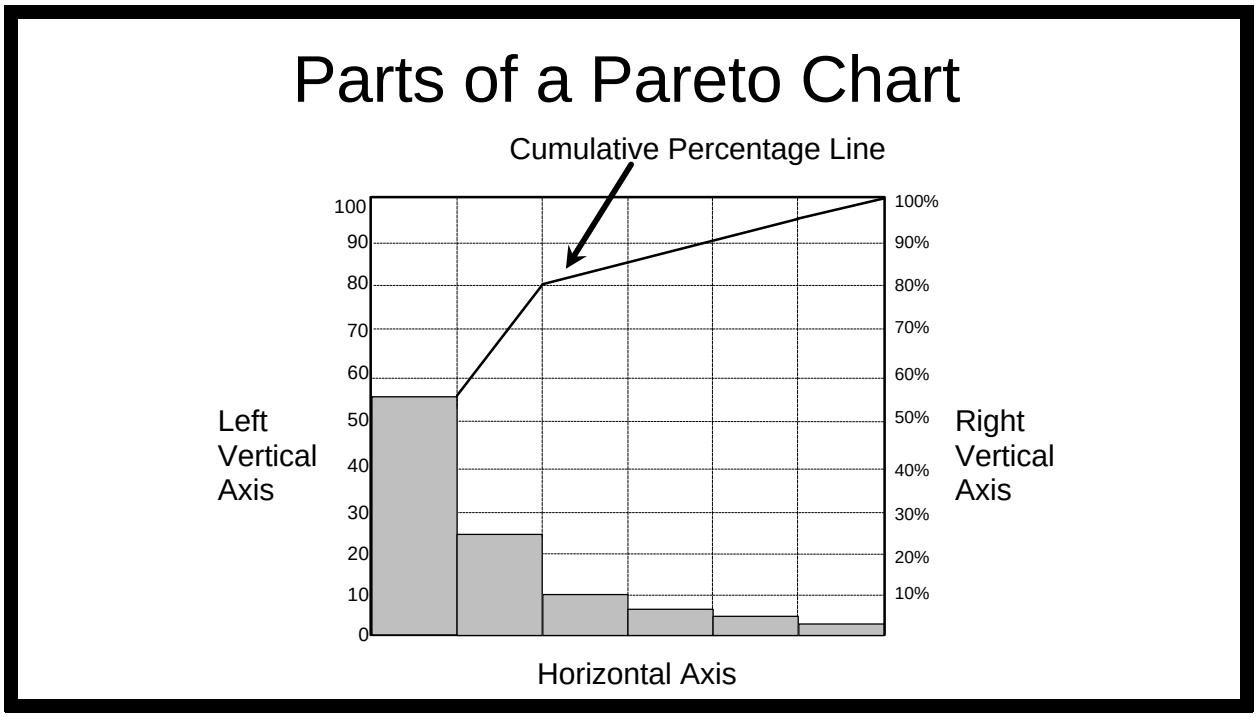
This concept was first articulated for use in quality improvement efforts by Dr. Joseph Juran. He pointed out that, in many instances, most of the losses of quality we see can be attributed to a relatively small number of causes. Dr. Juran said that if we classify these problems of quality loss into what he called the "vital few" and "useful (or trivial) many," we would know where to concentrate our efforts to effect the greatest improvement. He called this method Pareto Analysis.

- **"80/20 Rule"**

Dr. Juran based his theory on a concept commonly called the "80/20 Rule." This rule was developed by the Italian economist Vilfredo Pareto in the late nineteenth century. His studies showed that the distribution of wealth in society was uneven: the largest share of money was held by a very small number of people. Other scholars found applications for Pareto's findings in the worlds of business and, ultimately, quality control.

We now recognize that, very often, 80 percent of the losses of quality (defects, errors, etc.) are attributable to 20 percent of potential causes. That 20 percent represents the vital few on which we should focus our efforts to affect 80 percent of the losses.

It is important to remember that we shouldn't take 80/20 too literally. You won't always see an exact 80/20 relationship. You might see 75/25 or something similar. The point is that you want to identify those few causes which your data tell you have the greatest impact on the outcome of the process.



10/95 Team Skills and Concepts - Module 5, Viewgraph 23

Parts of a Pareto Chart

- **Left Vertical Axis**

The left vertical axis is displayed as a bar with a scale to its left. The scale shows the total count of each item in a particular category. The scale will be much higher than the largest category in order to accommodate cumulative totals.

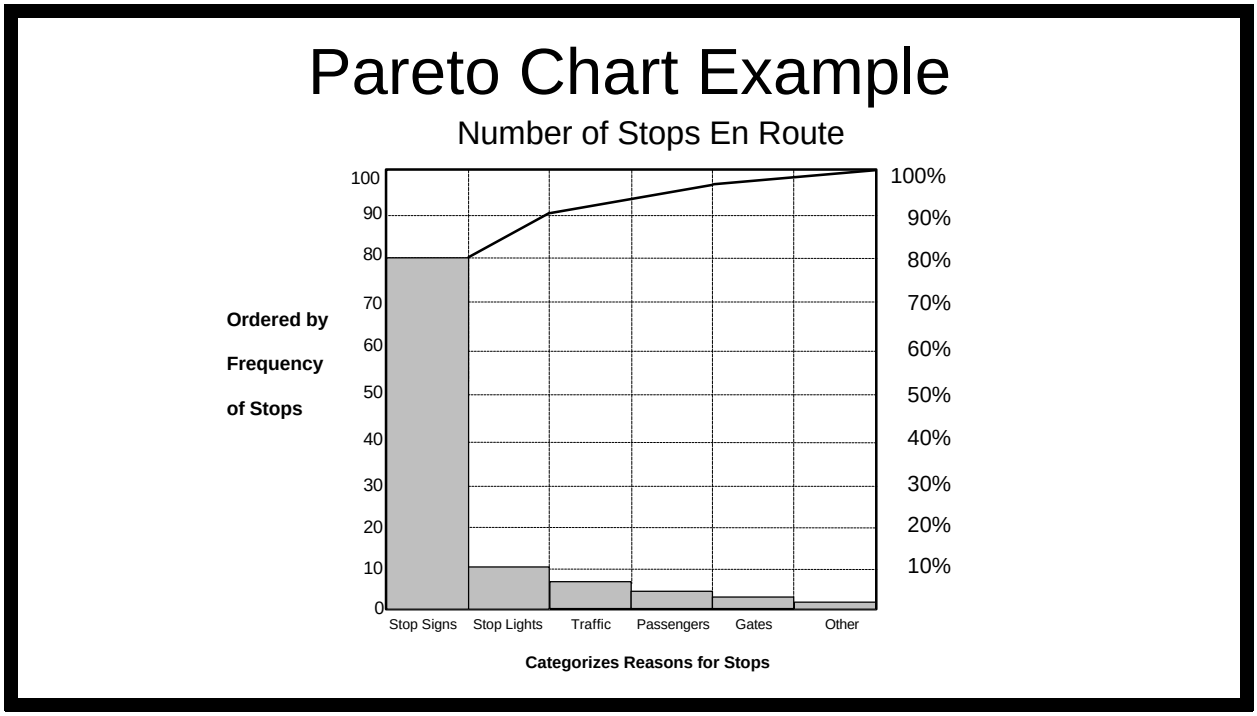
- **Right Vertical Axis**

The right vertical axis is shown by a line drawn above the bars. It displays the percentage each category represents of the total items being counted.

A **cumulative percentage line** or curve shows where the 80/20 point appears. This axis is not always shown, but many teams find it helpful for demonstrating the 80/20 rule. As you look at the examples, decide when it is most helpful to you.

- **Horizontal Axis**

The horizontal axis defines the categories for the items being displayed. Categories are represented as bars arranged in descending order from left to right (largest to smallest).



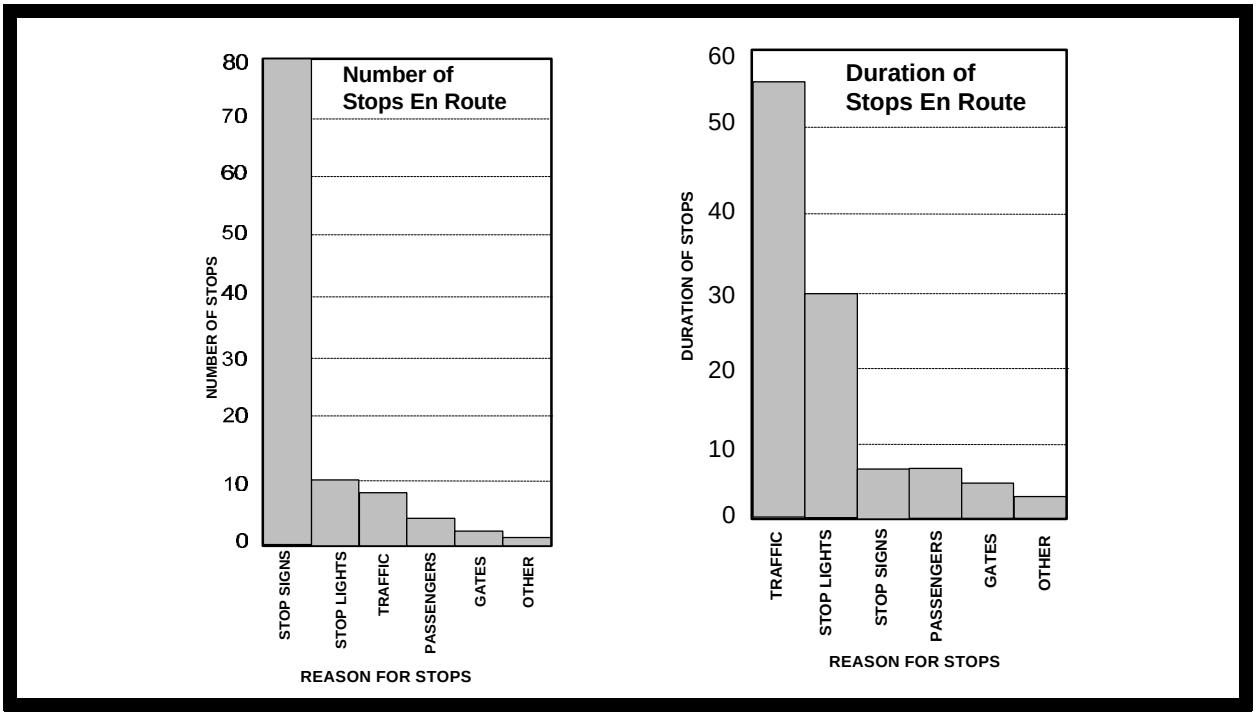
10/95 Team Skills and Concepts - Module 5, Viewgraph 24

Pareto Chart Example - Number of Stops En Route

This example, Number of Stops En Route, demonstrates how a Pareto chart displays the causes of stops in order of frequency of those stops (perhaps for a base shuttle bus). Notice that one category, Stop Signs, accounts for 80 percent of the total stops. With five categories identified, Stop Signs represents 20 percent of the causes. The cumulative percentage line allows you to see this very quickly and easily.

The Other category consists of causes that had so few instances of stops that it doesn't make sense to display them separately. The Other category generally should be smaller than the smallest category of individual items displayed. If it is larger than any of the other bars, you need to reexamine the categories.

You may be saying to yourself, "Well, it should have been obvious from the data that Stop Signs are the biggest cause of delays." But we have learned from experience that "a picture is worth a thousand words." Teams that have collected and worked with the data may intuitively be able to recognize the best opportunities for improvement. But Pareto charts and other graphic tools play an important role in visually demonstrating a team's findings to higher level teams and others interested in, but not intimately familiar with, the process. Also, as we will soon see, the picture looks different depending on what questions you ask.



10/95 Team Skills and Concepts - Module 5, Viewgraph 25

Number of Stops En Route/Duration of Stops En Route

The order of the items may shift depending on whether you are looking at frequency or magnitude.

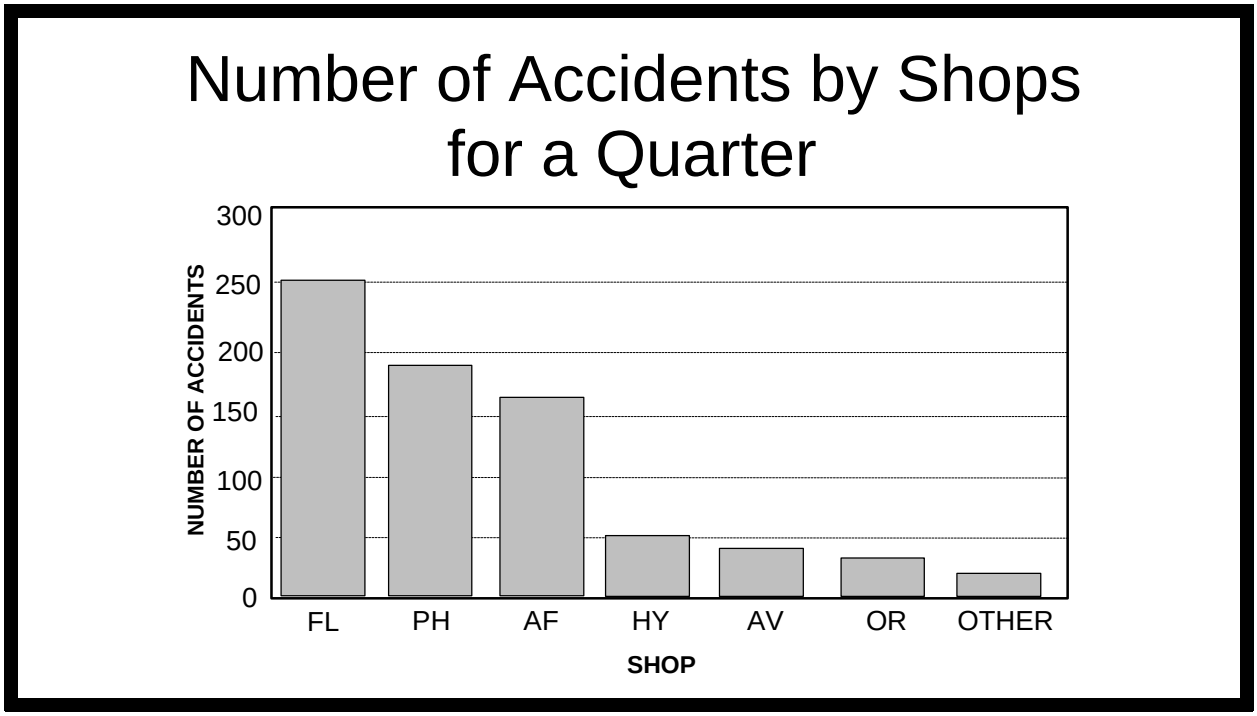
- **Number of Stops En Route**

As we saw a few moments ago, if we display causes of stops according to how frequently they occur, "Stop Signs" appears to be the most important cause.

- **Duration of Stops En Route**

However, if we measure and display the duration of the stops, we find in this example that "Traffic" is now the most important cause. It is important to remember that you often need to examine losses of quality from different perspectives in order to really improve the process. How you ask the question will usually affect the answer. For example, we need to ask which is worse for the customer: stops that last too long or too many stops? What is the overall aim of the improvement effort?

Now let's look at some examples of looking at different aspects of an opportunity for improvement.



10/95 Team Skills and Concepts - Module 5, Viewgraph 26

Number of Accidents by Shops for a Quarter

In this example, data has been collected to examine incidence of accidents in different shops (FL, PH, etc. are shop name acronyms), perhaps at an aviation depot.

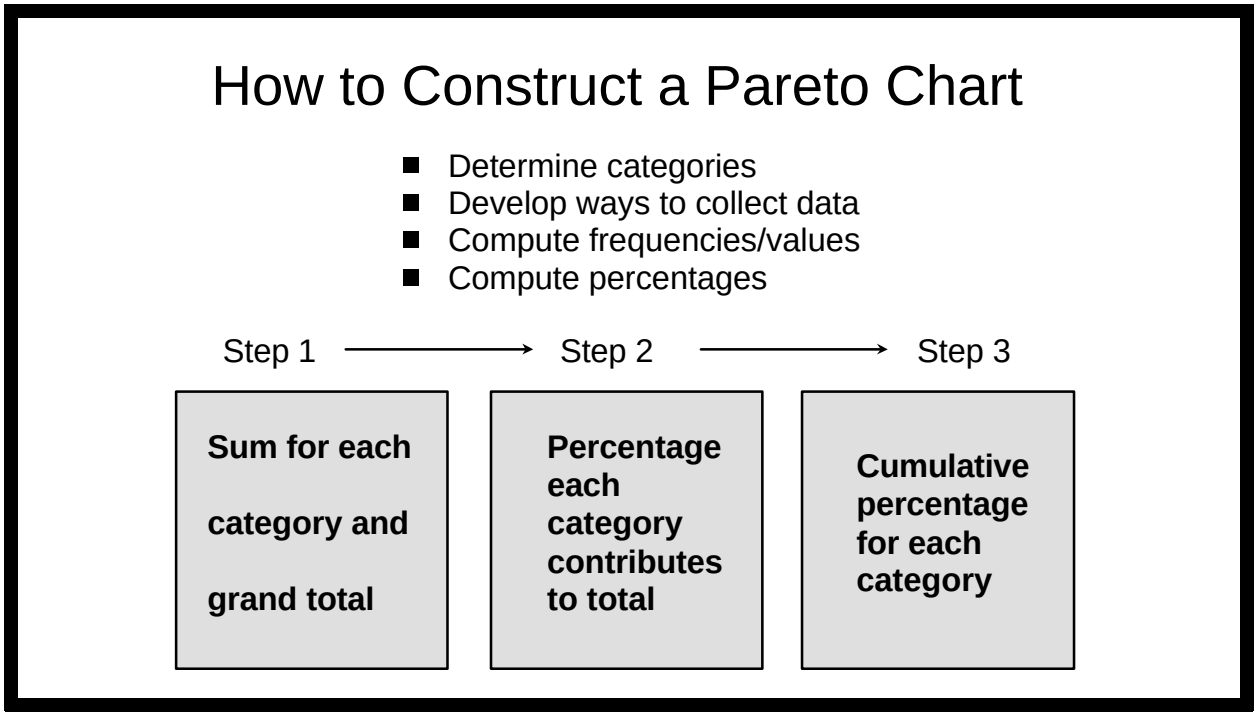
This Pareto chart indicates that, if we are interested in the *number* of accidents occurring in different shops, we will want to focus our efforts on the FL and PH shops.

10/95 Team Skills and Concepts - Module 5, Viewgraph 27

Days Lost Because of Accidents by Shop for a Quarter

However, if the *number of days lost* because of accidents is what we're really concerned about, this diagram shows us that the PH and OR shops are the ones to study.

Now that we understand what a Pareto chart is and how we might use it, let's learn how to construct one.



10/95 Team Skills and Concepts - Module 5, Viewgraph 28

How to Construct a Pareto Chart

In order to construct a Pareto chart, you need to do four basic things:

- **Determine categories**

First, you need to decide what you want to measure. Consider what step of the process improvement effort you are in: are you still defining the issue, or are you at the point of evaluating causes? If you are just starting to define the issue, you will probably be looking at categories such as defects, delays, complaints, and cost. If you have already identified the issue and are studying causes, such categories as shop number, type of equipment used, or source of materials might be appropriate. The cause-and-effect diagram would help you with this.

- **Develop ways to collect data**

Once you have determined the categories and types of data you need, you should develop a means of collecting the data. We will talk more about data collection methodologies next in this module.

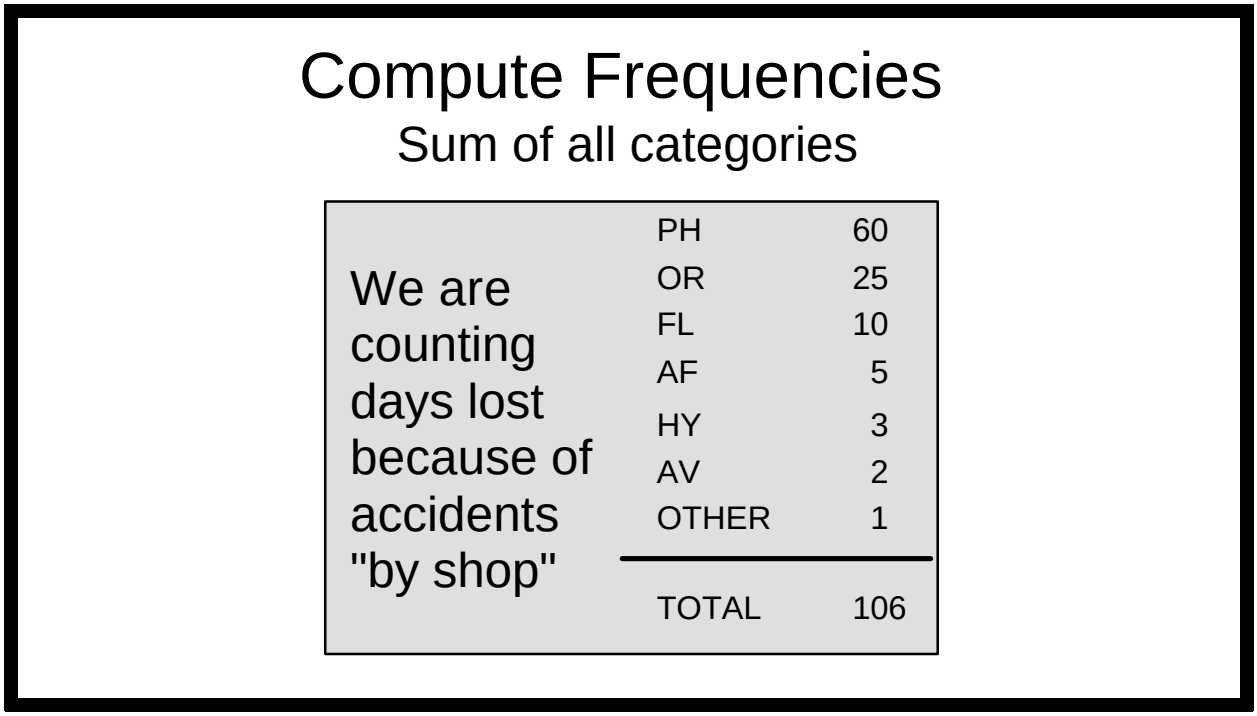
- **Compute frequencies/values**

As we saw in the earlier examples, you may need to aggregate the data according to frequency or magnitude—often both.

- **Compute percentages**

Finally, to identify the "vital few," you will need to know some percentages.

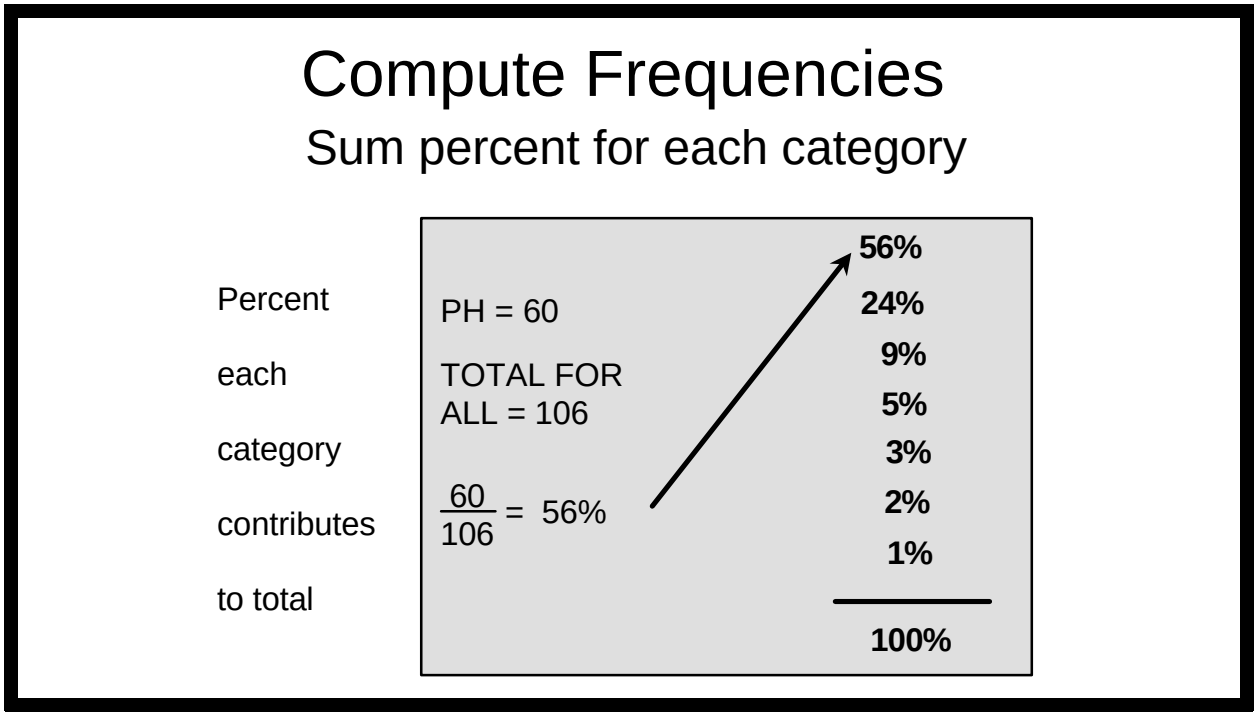
Let's look at the mathematical steps one at a time. You'll find that they're very easy to do.



10/95 Team Skills and Concepts - Module 5, Viewgraph 29

Compute Frequencies: Sum of all categories

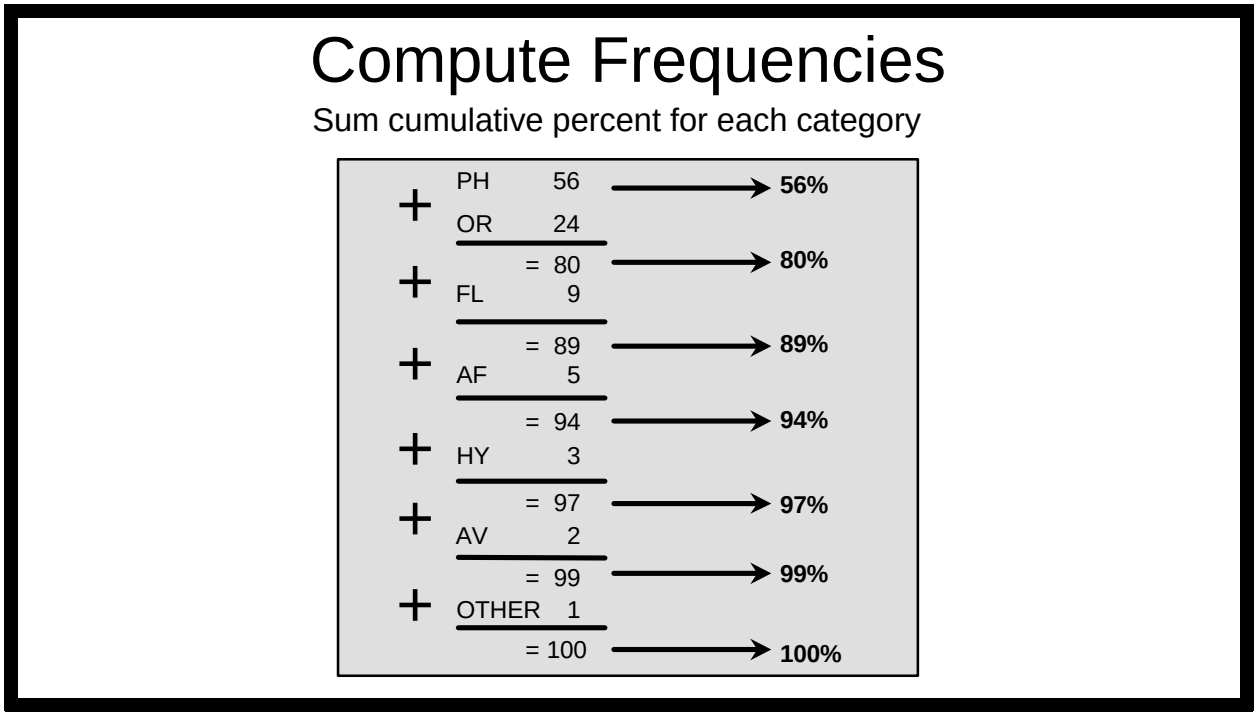
The first step is to simply add up the values for each of the categories. In this example, we are counting days lost because of accidents "by shop." As you can see, the total is 106. The largest category, shop "PH," lost 60 days because of accidents.



10/95 Team Skills and Concepts - Module 5, Viewgraph 30

Compute Frequencies: Sum percent for each category

In the second step, we compute for each category the percentage it contributes to the total. Add them up to make sure they equal 100 percent. Depending on how you round off, you might get 99 or 101 percent. That's okay. Remember, we're looking for that rough 80/20, not a precise percentage.



10/95 Team Skills and Concepts - Module 5, Viewgraph 31

Compute Frequencies: Sum cumulative percent for each category

The third step is just a matter of adding each of the percentages, one at a time, to get a running cumulative percentage. Starting with the largest category, shop PH, which is 56 percent, we first add shop OR's contribution, which is 24 percent, to get a cumulative of 80 percent. Next we add nine percent for shop FL to get 89 percent, and so on. The total should equal 100 percent.

Once you have finished your computations, you are ready to display them on a graph as we discussed earlier.

10/95 Team Skills and Concepts - Module 5, Viewgraph 32

Days Lost Because of Accidents by Shop for a Quarter

Let's discuss how to enter the data just computed on the diagram.

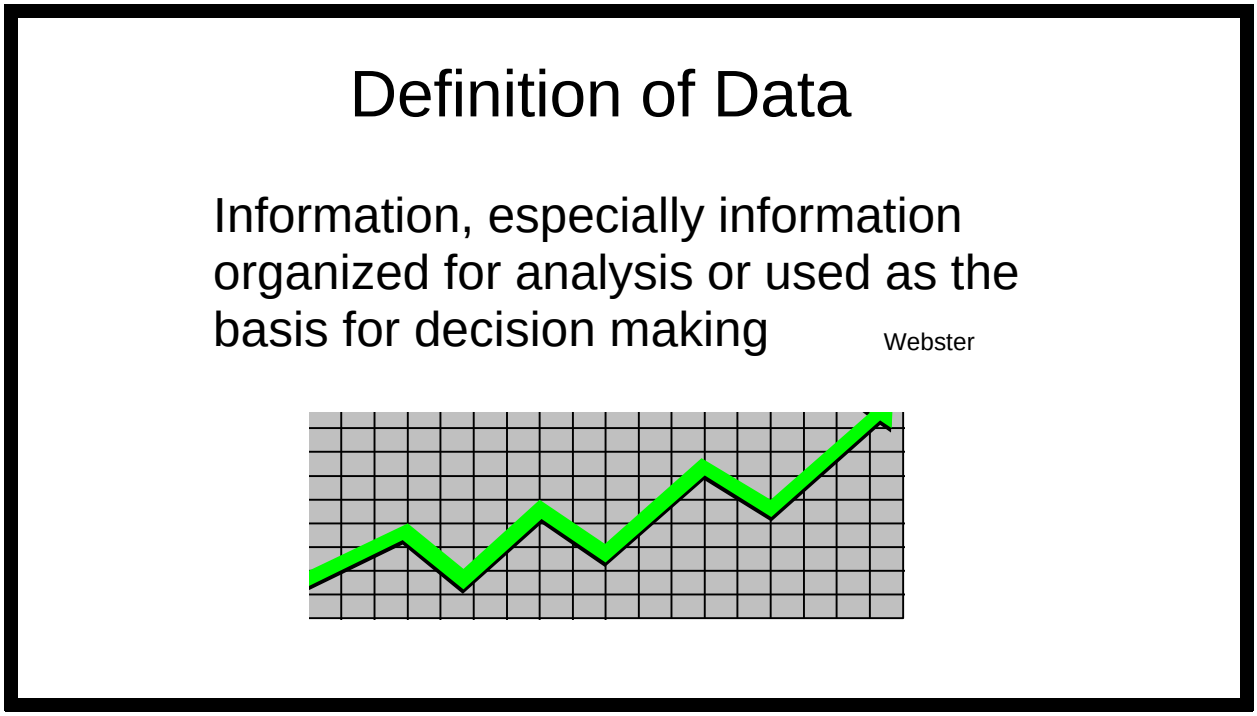
This is the completed Pareto chart for the data we just computed. Notice that we made the scale on the left high enough to accommodate the total number of days lost by all of the shops (106). This gives us enough room to show a percentage scale on the right, and a cumulative percentage line so we can really see the 80/20 Rule in effect. When you draw the cumulative percentage line, always begin the line at the right top corner of the highest bar. The cumulative percentage for shop PH alone is 56; for PH and OR together, it is 80; and so on. The line will level out at 100.

Some Pareto charts show the cumulative percentages as a curve or arc; occasionally it is not shown at all. Once again, as a QMB or PAT, you will probably know immediately which categories represent the vital few. But for real visual impact, show the line or curve that demonstrates the 80/20 Rule.

As we have done here, be sure to label the axes and categories. It is also a good idea to title the chart. You may also want to use a legend to show the time period covered or other data (point of contact for data collection, etc.)

PARETO CHART CASE STUDY EXERCISE NOTES

Please be cautious when using Pareto charts. Pareto analysis is most useful when we are dealing with a stable, predictable system. Pareto charts, including stability and predictability, will be discussed in more detail in the *SAPI* course.



10/95 Team Skills and Concepts - Module 5, Viewgraph 33

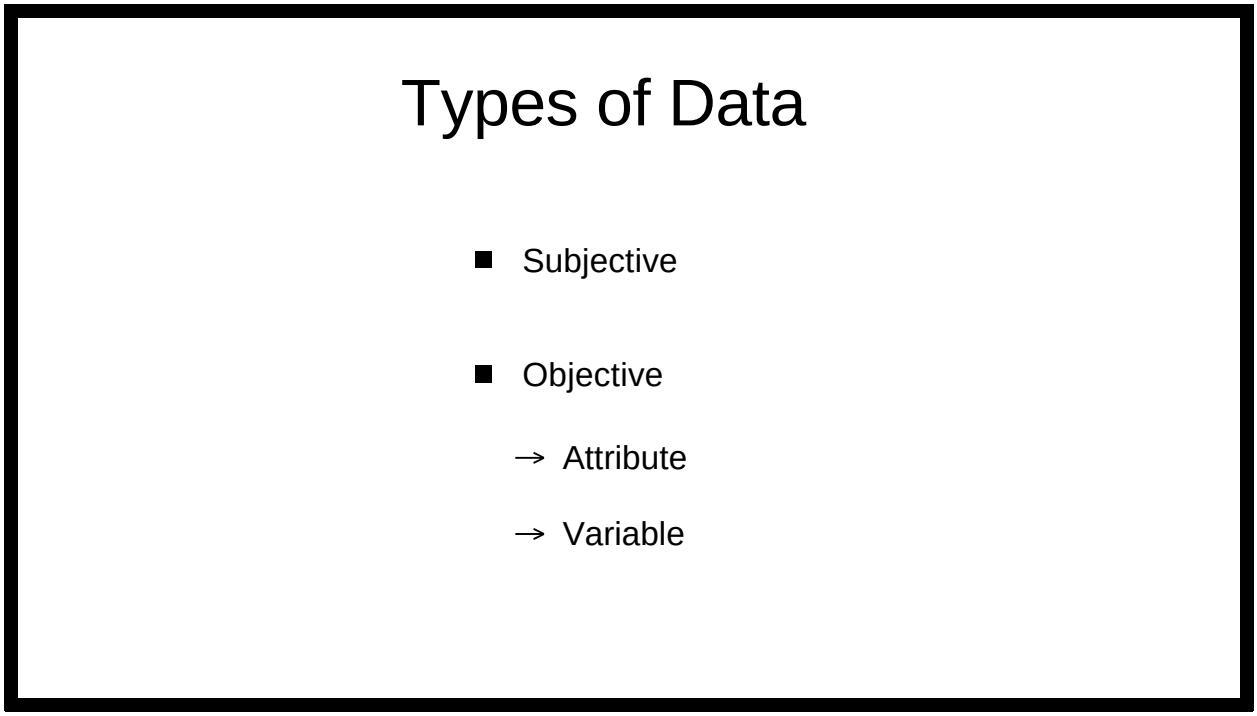
Definition of Data

Pareto charts and some of the other basic process improvement tools you will apply involve the use and collection of data. What is data?

Webster's II (New Riverside University Dictionary) defines data as:

Information, especially information organized for analysis or used as the basis for decision making.

When properly organized and analyzed, data will provide us with useful information and serve as a basis for making decisions about how to improve processes. Dr. Deming said, "It is the job of management to plot points, to know whether the process is stable, and to help their people do a better job." To do a better job, you must have data.



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Types of Data

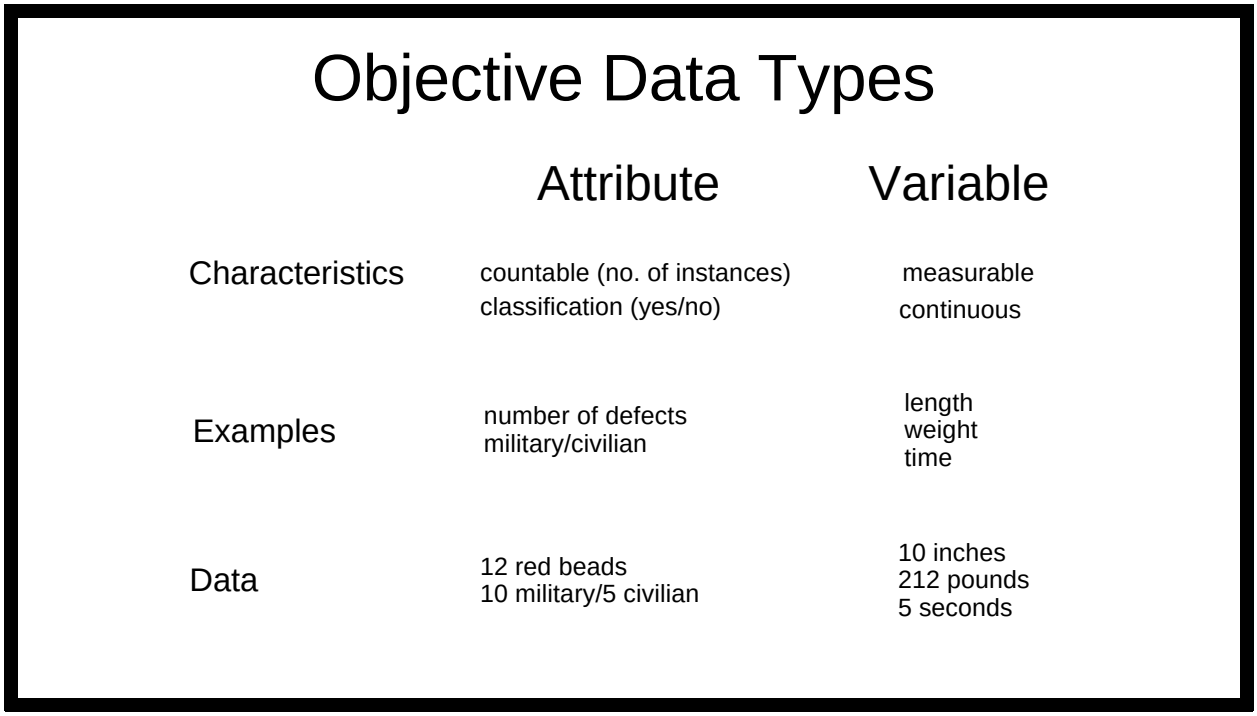
Data may be either subjective or objective in nature.

- **Subjective**

Subjective data are generally based upon experience, intuition, or expert opinion, and can be generated by cause-and-effect diagrams, brainstorming, and/or flowcharting. They are usually language data.

- **Objective**

Objective data are based upon fact, numbers, and/or statistics, and may be classified as either **attribute** data or **variable** data. If you look in your Student Guide, you'll see some characteristics, examples, and types of attribute and variable data.



10/95 Team Skills and Concepts - Module 5, Viewgraph 35

Objective Data Types

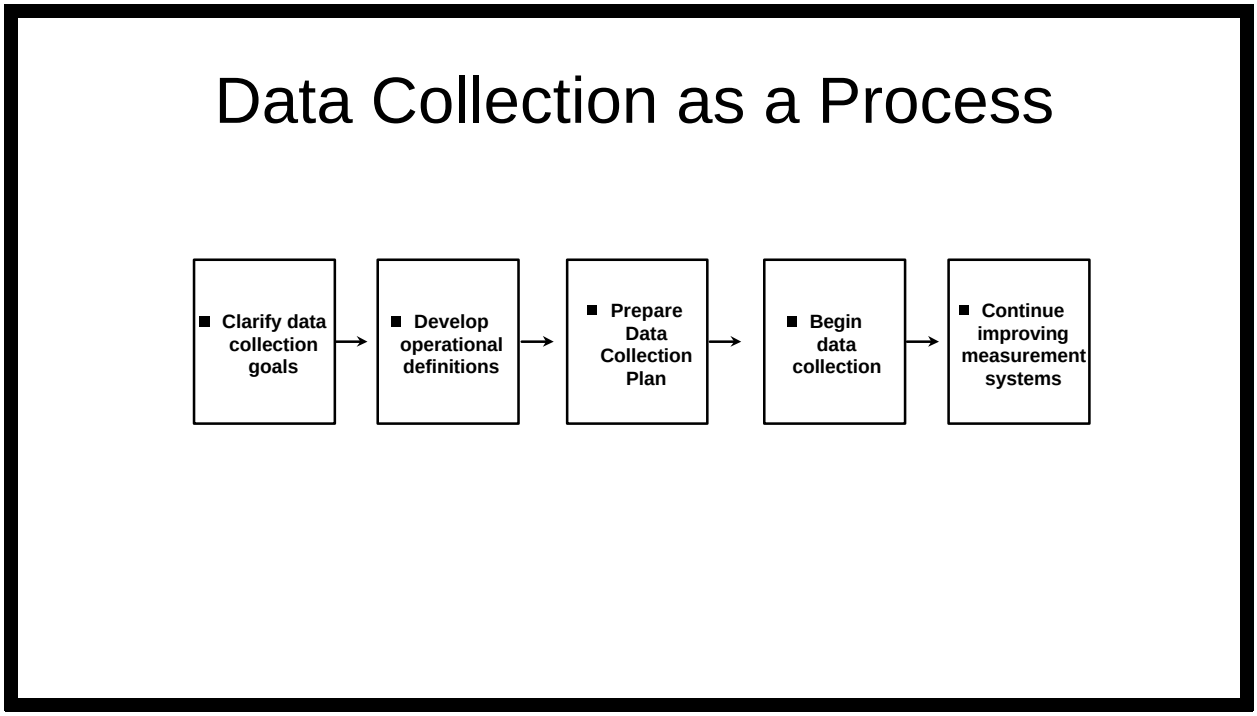
- **Variable**

Variable data are values resulting from measurements of a continuous variable (*DON TQL Glossary*). Examples are length, weight, time, temperature, distance.

- **Attribute**

Attribute data are gathered by counting the number of occurrences or items in a single category of similar items or occurrences (*DON TQL Glossary*). Examples of this type of data are the number of accidents or the number of defects.

A good example of attribute data is the Red Bead Experiment in which you counted the number of defects (count: 15 red beads/10 white beads).



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Data Collection as a Process

Collecting meaningful data is one of the most important aspects of process improvement. There are many ways in which data can be in error. The data may not be the kind you need. Data that should not be combined may have been mixed. Data collectors may use different procedures unless they are specifically taught what to do. There may be bias in the data collection process. The possibilities for error are almost endless.

It's important to take the time to plan how data will be collected. To do that, let's take a look at data collection as a process.

- **Clarify data collection goals**

Clarify data collection goals by having a clear definition of the issue and the specific portion of the process from which the data will be derived. As we saw with Pareto charts, it is important to specify the questions that will be addressed by these data.

A list of questions to guide this portion of the process is helpful.

- **Develop operational definitions**

Operational definitions translate the concept you are trying to understand into procedures that everyone can follow when measuring or discussing it. An example of an operational definition is "on time." Does that mean within minutes, hours, or days? What kind of data will allow you to attach a value to this concept? What standards or measurements will you use? (You will learn more about operational definitions in the *Systems Approach to Process Improvement* [SAPI] course.)

- **Prepare Data Collection Plan**

What procedures will you use for collecting this data? How will the data be obtained and recorded? For example, are there current data bases, data collection aids, checksheets, survey forms, or automated collection procedures? Do your customers or suppliers collect the same kinds of data? What procedures or instruments do they use? Are your definitions, standards, and procedures comparable to those used by customers and suppliers?

You need to think about what type of statistical tools or graphs may apply, and how the data will be summarized as you design the procedures and data collection techniques you will use.

- **Begin data collection**

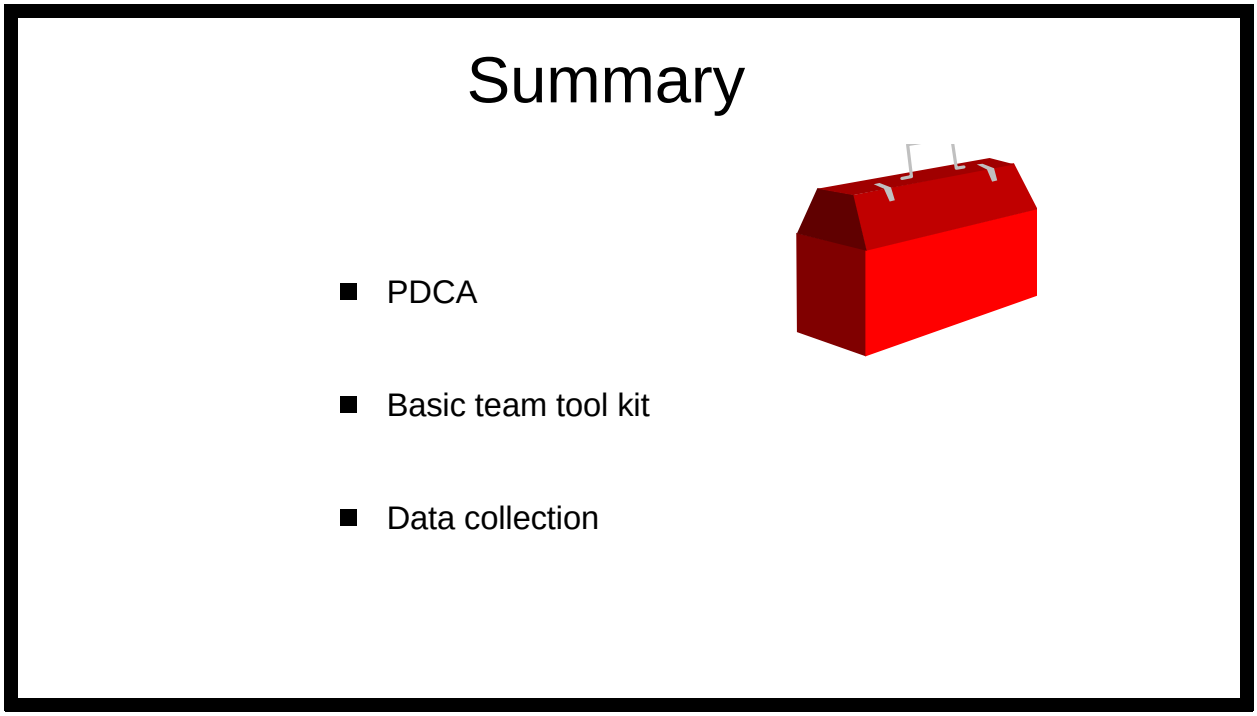
Before you begin actual collection, explain the operational definitions and procedures to all data collectors, especially if there are some who are not on the team. Have all data collectors follow the procedures developed. The quality advisor may need to watch and instruct beginning data collectors.

It's important to consider the impact data collection may have on other workers in the process. Make sure everyone is informed of the purpose of the data collection effort and that they receive feedback about the outcome. It is not an inspection!

- **Continue improving measurement systems**

As with all aspects of process improvement, the process of data collection for measurement and analysis is one that we should continuously work to improve. It is a part of the PDCA cycle.

Our intent here is to introduce you to the basics of data collection. You will learn more about this subject in the *MMQ* and *SAPI* courses. If you need more information before you attend those courses, Chapter 5 of *The Team Handbook* provides additional guidance.



10/95 Team Skills and Concepts - Module 5, Viewgraph 37

Summary

- **PDCA**

We learned the phases of the plan-do-check-act cycle and how to apply the tools. It's important to note that the tools should be used whenever they can help you accomplish a task, not necessarily just in the order we have chosen to illustrate their use.

- **Basic team tool kit**

We constructed flowcharts, cause-and-effect diagrams, and Pareto charts. We also learned the steps and rules for conducting brainstorming, multivoting, and nominal group technique.

- **Data collection**

We introduced some basic definitions and considerations for data collection.

NOTES